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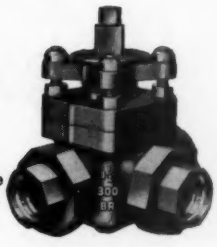

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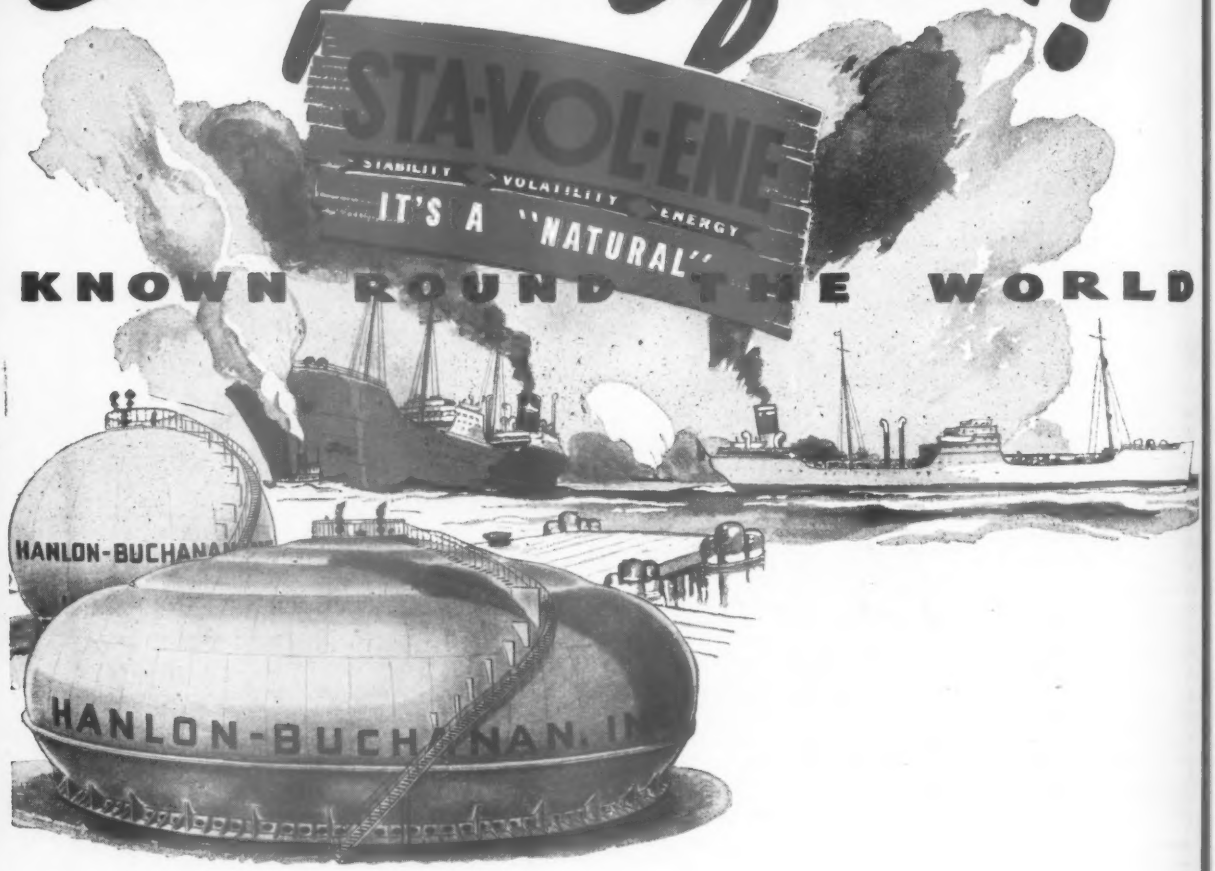
Cargoes Afloat!



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Trends

Crude-Oil Production
By States—Page 166

CRUDE-OIL STOCKS 219,999,000 bbl. as of Nov. 10—down 1,032,000 bbl. One year ago 222,467,000 bbl.

GASOLINE STOCKS 78,188,000 bbl. as of Nov. 10—up 1,637,000 bbl. One year ago 77,873,000 bbl.

RESIDUAL FUEL-OIL STOCKS 45,936,000 bbl. as of Nov. 10—down 192,000 bbl. One year ago 64,122,000 bbl.

GAS OIL AND DISTILLATE STOCKS 45,126,000 bbl. as of Nov. 10—up 316,000 bbl. One year ago 47,281,000 bbl.

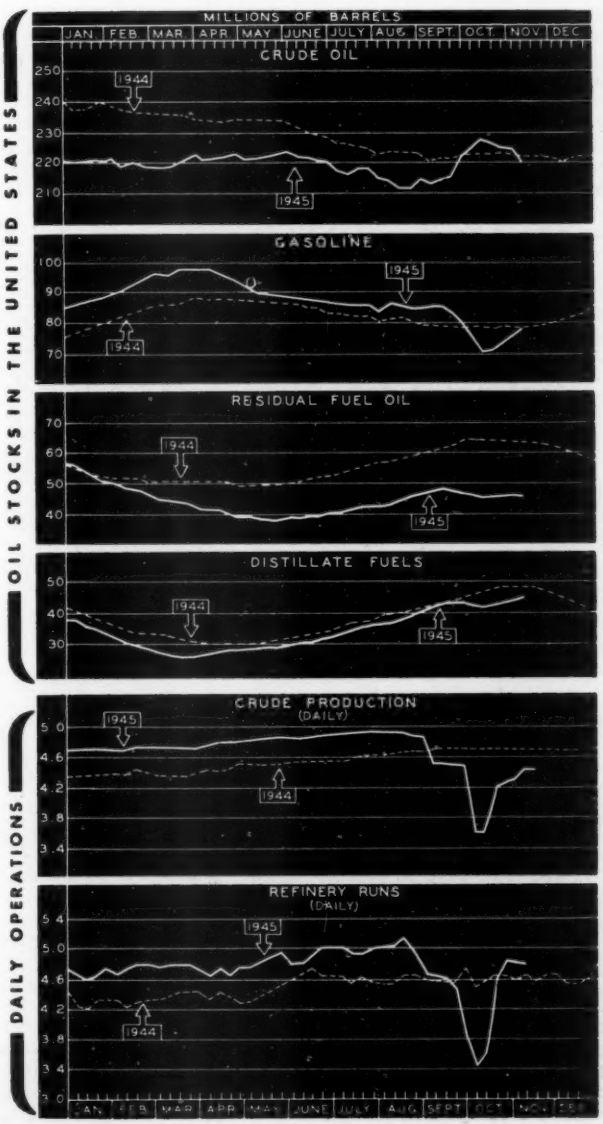
CRUDE-OIL PRODUCTION 4,467,500 bbl. as of Nov. 17—up 7,850 bbl. One year ago 4,736,300 bbl.

REFINERY RUNS 4,789,000 bbl. daily week ended Nov. 10—down 18,000 bbl. One year ago 4,682,000 bbl.

REPORTS from representative sections of the country leave no doubt that the demand for petroleum products in this country is running ahead of the expected requirements for the early postwar period. This situation appears universal.

OUTSTANDING has been the demand for motor fuels. Most of the industry's economists felt that they were on the liberal side in projecting gasoline needs in this country for the year or half-year which started September 1. They took into consideration the reduced number of registered cars and the fact that the use of these cars would be restricted for a time because of the tire situation. While no data are available to show actual consumption of gasoline by uses over the past 3 months, it is certain that the automotive demand is greater than the early fall projections, reflecting the desire of owners to get the maximum use of their cars regardless of obstacles to be overcome. Those connected with the retail sale of gasoline state that the agricultural demands have also been much greater than they expected. In the Middle West there are individual reports showing increases of 25 to 50 per cent over sales in the fall of 1941. This reflects the prosperity of the farming areas and the emphasis placed on the maximum output of agricultural products. Any weakness in tank car gasoline prices is confined to local areas.

OUTLETS for intermediate products of refineries ranging from heavy gas oils to kerosene are also greater than expected by most refiners. A greatly enlarged diesel-fuel demand in the postwar period is indicated in the various types of sales to domestic users since the end of the Japanese war. It is predicted that the consumption of furnace oils for the season now under way, will exceed that of any previous year, assuming that the oils are readily available. At many plants this has brought a situation in which operators have been compelled to cut more deeply into their crude-oil charging stock than they had planned, with corresponding reduction in the quantities of residual products available. This in turn has brought a continued tight fuel-oil market. These developments in the coastal areas are pointing to an operating condition in which maximum yields of light-end and intermediate products will be necessary with imports of fuel oils to supply any deficiencies in that product.



General Agreement Expressed on Disposition of Facilities

by Henry D. Ralph

WASHINGTON.—With one highly important exception, the entire oil industry is virtually in accord on policies which should be followed in disposing of government-owned petroleum facilities, it appeared at hearings held last week before the special Senate committee on petroleum resources.

The exception is the method of valuing and selling the catalytic-cracking plants built by Defense Plant Corp. during the war for manufacture of 100-octane aviation gasoline and now capable of producing high-quality motor gasoline.

Small refiners who operated such plants under lease during the war want the right to buy them under a valuation formula which would result in a relatively low price. Major companies, which installed similar facilities with their own funds, want these crackers valued under a formula which would result in a higher price. Independent refiners with no cat crackers side pretty much with the majors on this point. Spokesmen for all three groups presented their views, basing their arguments chiefly on their competitive positions in the coming "octane race" for the motor-gasoline market.

Pricing Recommendations

There was divergence of view on the pricing formula for government-built tankers for coastwise use, but no important exceptions were taken to industry committee recommendations that:

1. The two big-inch lines of War Emergency Pipe Lines, Inc., should not be used, in whole or in part, for oil transportation, by any company or group of companies or by the Government; neither should they be scrapped, but should either be maintained in standby condition for some emergency or should be converted to the movement of natural gas from Texas to the Atlantic Seaboard.

2. The other government-owned emergency pipe lines appear to have no economic value in place and should be sold to the highest bidder for salvage or whatever use a purchaser cares to make of them.

3. Tank trucks, towboats, tugs, and barges should be sold promptly to present operators or others at the highest bids or at negotiated prices based on appraised value, taking into consideration their postwar utility and replacement costs.

4. Synthetic-rubber facilities in the petroleum field for the most part probably will be operated for some time, so their disposition is not an immediate problem. Other government-owned facilities of a refining nature, such as isomerization, alkylation, and toluene, probably will have little postwar value, and their method of disposition would not greatly disturb the economics of the industry, so they may be sold to present operators at fair negotiated prices or to the highest bidder for salvage.

These conclusions and recommendations were presented by a special industry group appointed by the heads of several oil-trade associations. W. Alton Jones, president of Cities Service Co., was general chairman. Members of the group presented to the Senate committee data on all phases of government-owned petroleum property.

Jones Suggests Principles for Disposal

JONES presented seven general principles which the entire industry agreed should govern government disposition of surplus petroleum facilities. These were:

1. The Government should not attempt to operate surplus plants, pipe lines or other similar facilities. The oil industry believes in the free-enterprise system and believes that there is no place in such a system for Government in business. There is no half-way measure—free enterprise cannot endure with Government as a competitor.

2. As soon as possible those facilities which are commercially and economically usable in normal peacetime operations should be sold and the Government's investment in them liquidated. Generally speaking, we are opposed to long-term leases of plants by the Government to private operators since such leases would in effect continue the Government in business.

3. Those facilities which are not commercially usable should be closed up and adequately protected so that they would be immediately available in the event of another emergency. Except in unusual instances, we do not favor scrapping anything which may serve this country in time of need. We believe our chances of maintaining peace are directly in proportion to our ability to protect ourselves against warlike tendencies of other nations. The Government can well afford to make such expenditures as are necessary to maintain in working order war plants and other facilities in the same manner as it maintains its Army and Navy.

4. Sale of surplus facilities should be handled in such a manner as not to disrupt the normal functioning of the industry. If by placing government-owned properties in private hands, existing industry facilities would be displaced and abandoned, we feel it would be better for the economy of the country for the Government to hold such facilities in idle reserve.

5. Facilities should not be sold on a basis which would give purchasers unfair competitive advantages. The Government is in a very disadvantageous trading position in selling a surplus plant adjacent to a private plant and of use only to the operator of the private plant. Rather than demoralize the industry's operations by selling at less than the value to the purchaser, thereby vesting in such purchaser a competitive advantage, the Government, in the general welfare, could better spend additional sums for holding such properties inactive until needed.

6. Believing as we do that competition is the life blood of free enterprise, no sales should be made which tend to create monopolies. For example, if utilized at all for oil transportation, government pipe lines must operate as common carriers, available to all independents as well as to the major companies.

7. Finally, in the discussion of policy, it should be kept in mind that for the most part these government-built plants and facilities have served their purpose. They are, in a sense, expendables. Other implements of warfare on battlefronts and in storerooms become obsolete on Armistice Day. War is waste. We disregard this in the heat of conflict. Being human, when the ordeal is over and the danger passed, we try to salvage, to reclaim waste. This is right and proper, but perspective should be preserved. We should not lose sight of the larger peacetime objective, a greater national income, productive work for anyone who wants it, the nation's solvency preserved. It is possible that after spending 300 billions to insure free enterprise, we may, in an effort to save a few millions at the spigot, lose the greater objective.

Baker Reviews Peacetime Values

THE majority view on refinery disposal was presented by Hines H. Baker, vice president of Humble Oil & Refining Co., prefacing his conclusions with a detailed description of the types of refinery equipment built by the Government.

Baker stated that government-owned facilities for the manufacture of war products at petroleum refineries in the United States constitute an investment approximating $543,000,000. This investment is for the supply of three primary products: 100-octane gasoline, for which there is an investment by the Government of $238,000,000; toulene, $21,727,000; butadiene and butyl rubber $283,000,000. The chief economic interest at present, he explained, is in the 100-octane facilities, particularly the catalytic-cracking equipment. The postwar market for 100-octane is estimated at only 10 to 15 per cent of the wartime level, or around 90,000 bbl. per day, but these plants are important because they can be adapted to the production of high-grade motor gasoline.

Based on an estimated total investment of $1,000,000,000 in 100-octane facilities, Baker said the government investment is 23.8 per cent of this and accounts for only 12.6 per cent of productive capacity. The discrepancy was described as due to the fact that government-owned plants were generally for the purpose of obtaining marginal production and are often less efficient than the privately owned plants. In spite of the fact that private investments in 100-octane facilities are more than three times as great as government investment, Baker said the disposal of government plants could greatly influence the economics of the refining industry if policies are such as to give purchasers an unfair competitive advantage.

"It is difficult," reported Baker, "to determine at this time precisely the extent to which refining facilities installed for the manufacture of war products can be utilized profitably in normal peacetime competitive operations. A study of all the factors involved makes it possible, however, to arrive at reasonable conclusions as to the peacetime utility of various types of equipment."

The relative peacetime utility of the different types of government-owned units was reviewed by Baker.

Catalytic-cracking units, he said, have a definite, assured, and attractive place in peacetime refining operations.

In general, thermal reforming units can and will be used in the manufacture of motor gasoline.

Alkylation and isomerization facilities appear to have only a limited use, due to the fact that during the war the majority of these units were built for the specific purpose of increasing aviation - gasoline production.

The government-owned hydrogenation plants as used in wartime do not appear to have any place in normal refinery operations. Their value depends entirely upon the feasibility of conversion to other uses and the need of the operating refinery for the type of equipment to which the units might be converted.

Government-owned dehydrogenation units have little value as such, and their sale value is perhaps limited to the salvage value of component parts.

Facilities for the production of toluene and other aromatics will continue to have some utility, at least to the extent that such aromatics can be utilized in the solvent and chemical raw-materials trades. Improvement in naphtha quality for motor - gasoline manufacture by using the hydroforming units in toluene plants may be economically attractive in some instances.

The low-cost plants manufacturing butadiene from petroleum, all owned by the Government, nine in number, have a total rated capacity of 350,000 tons per year, or 51 per cent of all butadiene plants, including those plants producing butadiene from alcohol. In the absence of greatly reduced price for alcohol, it is apparent that these nine plants will be in the best position to compete with natural rubber. The ability of synthetic rubber to compete with natural rubber depends upon the extent of improvement in operating techniques, cost of production, international trade relations, and other factors not at this time determinable.

Butyl rubber is superior to other types of rubber, both natural and synthetic, for use in the manufacture of inner tubes and for certain other uses. Accordingly, it may well continue to be manufactured as a peacetime product.

Diverse Views Offered by Independents

THE chief controversies arose from Baker's recommendations that cat crackers and other equipment with a definite place in normal refining operations be sold at actual cost, adjusted to prewar construction prices, less depreciation, or at current replacement cost less depreciation; that terms of sale include a large down payment and a short-term loan at commercial rates of interest; that the Government give no financial assistance to a purchaser to remodel a plant and that no long-term leases be permitted.

Chairman O'Mahoney remarked that these sale terms seemed more severe than anything suggested by government disposal agencies, and Sam H. Husbands, a director of RFC, observed that his agency was "tough, but not that tough."

HINES H. BAKER

PAUL BLAZER

Two industry witnesses who presented views at the O'Mahoney hearing were Hines H. Baker, vice president, Humble Oil & Refining Co., and Paul Blazer, chairman, Ashland Oil & Refining Co.

Chief opponent of the Baker proposals was M. H. Robineau, president of Frontier Refining Co., Cheyenne, Wyo., a member of Baker's subcommittee, but speaking for 11 of the 14 independent refiners with war-time leases for operation of government - owned 100 - octane plants.

Robineau asked for far more liberal methods of determining value, pointing out that the DPC facilities were built at high cost for a specific purpose and that their true measure of value is their use to a prospective purchaser after being adapted to civilian products and in the postwar competitive market for those products. For that reason he opposed rigid rules of cost determination and asked that sales prices be negotiated with the wartime operators. He also sought long-term leases as a means of determining the use value of these refineries, and government credit assistance in their purchase and remodeling.

Robineau's chief argument was that major companies which constructed cat crackers with their own funds during the war already have a competitive advantage in the octane race since their plants were constructed under "certificates of necessity," which permitted rapid write-off of depreciation and amortization, and with the aid of government contracts to purchase 100-octane.

Much the same arguments were presented by Paul Blazer, chairman of Ashland Oil & Refining Co., Ashland, Ky., and in a statement filed on behalf of M. Lloyd Freese, president of Associated Refineries, Inc., Duncan, Okla. They contended that the government plants contained much equipment of no use for commercial operation and should have a lower value than the privately built plants because they were not so well integrated into the refineries to which they are attached. They asked for long-term leases, where necessary, in order to determine by experience the actual commercial use value of the DPC facilities.

Still a different view was presented by G. L. Rowsey, president of Taylor Refining Co., Taylor and Corpus Christi, Tex., also a member of the Baker subcommittee, but speaking on behalf of all independent refiners owning no cat crackers and not operators of DPC plants. He said that in the octane race he did not fear competition from major refiners as much as competition from independents who might purchase government cat crackers at a low price.

He asked that government-owned facilities be frozen for 2 or 3 years in order to permit further experience in operating 100-octane plants for motor gasoline and to give independent refiners an opportunity to build their own cat crackers if they conclude it is desirable. He particularly opposed giving lenient purchase terms to wartime operators of DPC plants, saying:

"It is generally conceded that the only government-owned facilities in the refining industry that will have an effective place in postwar refining operations will be catalytic-cracking units. On the basis of acquisition of this character of facility the refining industry is divided into four categories:

"1. Companies which purchased their facilities without benefit of certificates of necessity. (2) Companies which purchased their facilities during the war under certificates of necessity. (3) Companies operating plants owned by the Government. (4) Companies which did not build or operate catalytic-cracking facilities during the war and will be forced by postwar octane competition of those falling in the second and third categories to install such facilities.

Proposed Principles

"I deem it necessary in any plan of disposal of such facilities that the following principles be incorporated:

"1. The disposition of government-owned facilities should be handled in such manner as not to destroy the competitive position of the small companies which will have to provide their facilities with private capital.

"2. The facilities should not be leased except for the period of negotiation, which should be limited to 9 months or to the option period fixed by the contracts with the Government, if longer.

"3. The facilities should be sold by negotiation on the basis of post-war replacement cost less reasonable depreciation, from the date of completion to the date of sale, with a down payment of not less than 25 per cent and deferred payments to extend over a period not to exceed 5 years.

"4. Any existing government-owned facilities that cannot or will not be used in place by operators should be dismantled and sold to the highest bidder for cash and protection provided so that a third party cannot, by collusion, make such purchases and resell directly or indirectly to original operator for use in place."

Disposition of the big-inch pipe lines was the subject of greatest interest to the committee and the official observers, and voluminous data were put into the record by members of a subcommittee headed by B. I. Graves, of Tide Water Associated Oil Co. This included a study by E. Holley Poe, natural-gas consultant, which concluded that the lines could be converted to natural gas on an economical basis and without injury to future markets for coal. While he said the greatest injury would be to the market for home-heating fuel oil, no oil-industry witnesses opposed the proposal.

Hearing on Oil Pact Not Seen Soon

WASHINGTON. — Prospects for Senate hearings on the Anglo-American oil agreement before the early part of next year appeared here this week to be poor. Sen. Tom Connally of Texas, chairman of the foreign relations committee before which the proposed treaty would be discussed, has been vague about naming a date. The uncertainty is partly owing to the possibility that Congress may recess before certain "urgent" legislation has cleared the Senate.

The probable delay in hearings before the Connally committee means that formal ratification of the agreement will not be considered by the Senate until late January or February. The Anglo-American oil commission provided for in the agreement cannot, therefore, be organized until about the middle of 1946.

The criticism of certain domestic operators that the agreement fails to limit British imports from sterling countries has been offset by explanations from American delegates who participated in the London deliberations. Both governments, it was pointed out, wished to remain free of restraint on tariff and import regulations. There could be no qualifying paragraph on British imports without accepting the same binding language by the United States. It was chiefly the independent members of the American delegation who insisted that no import limitations should be considered. This attitude is thought to reflect the wish of American independents to keep the record clear for possible efforts later to restore the prewar import duty in this country.

New High in Oil Production Recorded in Venezuela

CARACAS.—Venezuelan oil production passed million-barrel-a-day mark November 5, when it set up a record of 1,007,039 bbl., almost double the best accomplished in the last peacetime year, 1938. Venezuela scored a new high in daily average production in October, with a record of 989,908 bbl. Creole Petroleum Corp., a Standard Oil Co. (N.J.) affiliate, was the largest producer, with a daily average of 539,916 bbl.

THIS WEEK

STRIDES— Wartime research reveals crude oil as "treasure house from which 500,000 of known organic chemicals can be produced," says Egloff. . . . Tires good for over 100,000 mileage. . . . Gasoline yielding 25 to 50 miles to the gallon. . . . "Haven't started to nibble at what nature has stored for us." . . . ¶Humble initiates airplane pipe-line patrol. . . . Flying at 500 ft. or less, pilot watches for telltale oil spots. . . . Covers 915 miles in 2 days. . . . ¶Wax fuel tablets, like those used in war for cooking and illumination, now made for civilian use. . . . Instant heat for camp cooking, thawing frozen pipes, etc. . . . ¶Catalytic cracking producing a fuel that gives more heat per gallon, thus cutting cost of heating homes. . . . Generally available this winter. . . . ¶New-type combustion-head for domestic oil burners designed to cut consumption 20 per cent. . . .

LABOR— Humble's 15,000 workers go on 40-hour week, 15 per cent pay increase. . . . Baytown Employes Federation the bargaining agent, but all workers share in benefits. . . . ¶Standard of Ohio, Sun, and Central Pipe Line refineries, seized by Navy last month owing to labor difficulties, returned to owners. . . . Few signs of settlement seen at 50 other seized plants. . . .

ECONOMICS— Big majorities piled up in Pennsylvania and Kentucky for constitutional amendments forbidding use of gasoline and other automotive taxes for other than highway purposes. . . . ¶Cosden asks railroads to adopt gasoline rates competitive with those charged by pipe lines from Mid-Continent to Middle West. . . . Action is latest in long series seeking reduction of freight charges. . . . ¶Poll conducted by I.P.A. of Texas shows 10 out of 17 major oil companies favor higher crude prices at the well and corresponding raise in prices of products. . . . Three-point program looks to 15 per cent increase in wages; 35-cent raise in price for crude; 1-cent raise for gasoline; ½ cent for kerosene. . . .

PRODUCTION— Navy explorers expect to uncover vast oil reserves in northwestern Alaska. . . . Test well at Umiat has encountered four oil-bearing sands in first 1,800 ft. . . . Expect free oil around 4,000 ft. . . . Drillers work in temperatures 50° below. . . . ¶Nation's crude output continues upward for fifth successive week. . . . Daily average 4,467,500 bbl., up 7,850. . . . Kansas leads with increase of 23,550 bbl., the only notable rise. . . . California drops 2,750 bbl., eastern area 4,850, Illinois 2,200, Wyoming 4,550. . . . ¶Completions total 578 for week, up 50. . . . Wildcat completions 71, compared with 85 in preceding week and 109 a year ago. . . .

FOREIGN— Refinery to be established in Australia, with 40 per cent of stock subscribed by California Texas Co. . . . Plan to provide crude from Persian Gulf. . . . ¶Venezuela passes 1,000,000-bbl.-a-day production. . . . Also scores new high in daily average output for month. . . . ¶Poland signs agreement to import crude from Russia. . . .

SURPLUS— W. Alton Jones tells O'Mahoney committee Government should get out of business of operating refineries, pipe lines, other federally owned facilities now surplus. . . . "Free enterprise can't endure with Government as competitor." . . . Presents seven principles to govern disposition of properties. . . . ¶President Robineau, of Frontier Refining, tells committee independents should have opportunity to acquire plants on long-term credit terms. . . . Frozen out otherwise. . . . ¶President Rowsey, of Taylor Refining, not so much afraid of competition from majors as from independents who might purchase cat crackers from Government at low prices. . . . ¶Only serious disagreement in oil industry over policies to be followed relates to method of valuing and selling these catalytic-cracking plants. . . .

NATURAL GAS— Governor Davis, defending Louisiana's policy of preserving natural gas for home use, tells FPC if it is forced to sell to other states Louisiana eventually will find its sole fuel supply "consisting of pine knots." . . . Former Governor Jones says early exhaustion of state's natural-gas reserves would be catastrophic. . . . ¶But Congressman McKenzie, whose district is on Monroe field, declares administration's policy is in direction of bureaucratic central government and violative of principle of free economy. . . . ¶C. H. Lyons, independent producer, says "too much government interference." . . .

The Middle East continues to hold the political as well as the petroleum spotlight. This week Iran, largest of the oil-producing countries of that area, secured the headlines with a revolution which may spread to Teheran, the capital, 450 miles north of the principal oil-producing fields. Upper view shows the Technical Institute for Iranians maintained at Abadan by Anglo-Iranian Oil Co., Ltd. Lower view shows well-head stabilizer of large flowing well in Gach Saran field

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Witnesses Tell FPC Louisiana's Gas Resources Are Jeopardized

NEW ORLEANS. — "There is no more reason for regulating gas than there is for regulating any other commodity," declared Charlton H. Lyons, independent producer, of Shreveport, testifying in the natural-gas investigation conducted here by Federal Power Commission. Lyons' view was in sharp conflict with that of other witnesses, who want restrictions imposed on movement of Louisiana's gas to other states.

The country is suffering from government interference, Lyons contended, adding: "When one thing is regulated, that throws something else out of gear. Then the second thing has to be regulated, and that circle continues on and on. Without all this regulation, most of these economic ills would cure themselves."

Sam Jones, former governor, who represents Louisiana on International Oil Compact Commission, was among witnesses who vigorously opposed sending this state's gas to regions which have other sources of fuel supply. Early exhaustion of Louisiana's natural gas would be catastrophic, he told the commission. "It would remove the only known source of fuel or energy indigenous to the state. It would deprive us of lifting power for unrecovered reservoirs of oil worth untold millions of dollars. It would take away a raw material from which thousands of products can be processed. It would cause fuel and electric rates to skyrocket. It would create havoc, not only within the state, but throughout the nation. It doesn't make sense—and argument till doomsday won't cause it to make sense—that areas favored with 3,000 years' supply of coal should take from areas having, at optimistic estimates, 35 years' supply of natural gas. It does make sense that we should share our gas with our sister state of Mississippi, which is in the same economic status and similarly situated so far as fuel is concerned."

H. W. Bell, engineer and geologist for the state director of natural-gas conservation, estimated that 2 trillion cu. ft. of gas remains in the Monroe field, indicating a life of 8 years at present rates of recovery.

Charles E. McKenzie, representative in Congress from Louisiana, a large part of whose district lies in the Monroe field, declared that "any curtailment of the market which might result in reduction of the field price for gas is of vital interest to the land owners and royalty owners."

McKenzie submitted resolutions adopted by the police juries (similar to county commissioners) of 12 parishes in his district, asserting that the effort of the Department of Conservation and the Public Service Commission to curtail or prevent exportation of natural gas from Louisiana is violative of the principle of free economy and detrimental to the welfare of the state.

"The right of any agency, federal or state, to determine the so-called inferior or superior uses of natural gas is the right to decide that the purchaser of natural gas cannot be permitted to sell such gas in interstate commerce and, realistically if not legally, is the power to control production," McKenzie asserted. "It is another step in the direction of a bureaucratic central government and in opposition to the right of free enterprise."

Gov. James H. Davis said it was the policy of the state to save its natural-gas for Louisiana and contiguous states which do not have other fuel resources. "When the day of exhaustion of Louisiana's natural gas arrives, as it inevitably will," said the governor, "the state will find itself high and dry, with its sole fuel supply consisting of pine knots and our other natural resources condemned to transportation to other states, with all the economic loss that such a situation entails."

Upon completion of testimony for and against Louisiana's plans for conserving its natural gas for home use, eight official witnesses from Arkansas, headed by Gov. Ben Laney, were to be heard. Next in the series of regional hearings in FPC's natural-gas investigation will be in Houston, opening January 28.

FPC to Consider Projects for More Gas for Iowa-Illinois

WASHINGTON.—Projects to supply additional natural gas to various communities in Iowa and Illinois have been set for hearing December 10 by Federal Power Commission.

Natural Gas Pipeline Co. of America and its affiliate, Texoma Natural Gas Co., seek authorization for $18,000,000 of construction to increase their delivery capacity from the present 268,000,000 to 349,000,000 cu. ft. per day. Natural plans looping totaling 285 miles of 26-in. pipe and 52 miles of 24-in., 20 miles of 20-in. lateral, 26 miles of 16 and 12-in. lateral.

Texoma plans 26 miles of 26-in. looping and increase in compressor station from 4,000 to 9,000 hp. As part of the same project Chicago District Pipeline Co. plans 23 miles of 24-in. pipe to serve its distribution areas with the additional gas.

On November 26 FPC will hear application of Tennessee Gas & Transmission Co. to lay 95 miles of 16-in. pipe from San Salvador field, Hidalgo County, Texas, to connect with its main line in Nueces County, and a dehydration plant, both with capacity of 99,400,000 cu. ft. and a total cost of $2,260,442. Tennessee is also asking authority to lay 2,380 ft. of 8-in. line in Harris County, Texas, at cost of $7,290, to obtain 50,000 M.c.f. per day from the Kay field via the Katy-Satsuma line of United Gas Pipe Line Co.

Manufacturers' Advisory Group Named by Bowles

WASHINGTON. — Administrator Chester Bowles has announced his appointments to a newly created oil-field drilling and producing equipment manufacturers' industry advisory committee which will cooperate with Office of Price Administration in establishing regulations affecting oil-field equipment manufacturers. The first meeting of the committee will be held in Washington December 4.

In a letter to each of the 14 members of the committee Bowles said: "We suggest that you make your appointment known to others of your industry so that their problems may be presented through you as their representative."

The members of the committee follow: Hugh H. Glen, president Emsco Derrick & Equipment Co., Los Angeles; Dow D. Warren, assistant to president, Reed Roller Bit Co., Houston; H. W. Cardwell, president Cardwell Manufacturing Co., Wichita, Kans.; T. Sutter, vice president Baker Oil Tools, Inc., Huntington Park, Calif.; W. Sievers, vice president Security Engineering Co., Whittier, Calif.; H. D. McLean, assistant to president, J. B. Beaird Co., Shreveport; Karl L. Elliott, treasurer Acme Fishing Tool Co., Parkersburg, W. Va.; J. H. Wilson, president Wilson Manufacturing Co., Wichita Falls, Tex.; R. M. Vickers, president Hydraulic Pump Co., Smackover, Ark.; A. M. McKinney, president National Supply Co., Toledo, Ohio; George C. Alten, president Alten's Foundry & Machine Works, Lancaster, Ohio; F. J. Spang, president Spang & Co., Butler, Pa.; W. B. Sharp, Houston; Rodney S. Durkee, president Lane-Wells Co., Los Angeles.

FOUNDED IN 1910

BY PATRICK C. BOYLE

the OIL AND GAS JOURNAL

The Next Twenty-Five?

As old-timers and others not so old reviewed past events of the petroleum industry at the twenty-fifth annual A.P.I. meeting last week the question was frequently asked, "What do the next 25 hold for our business?"

This conversational query, usually propounded somewhat facetiously, had a serious background. The passing of war's shadows was everywhere apparent at the Chicago meeting, but equally manifest were the many problems of peace.

There was general agreement in informal discussions that a projection of specific happenings over the next 25 years in the oil business would be as inaccurate and incomplete as predictions made shortly after the close of World War I have proved to be in the light of today's operations.

No operator of a battery of shell stills or the small pipe stills of the early twenties could conceive at that time of today's combination topping and vacuum units coupled with superfractionation and individual capacities ranging up to 85,000 bbl. daily. The most enthusiastic technicians of the early cracking days would never have envisioned catalytic processing and all the associated manufacturing operations of the recent emergency.

If a pipe liner of 1920 had foretold a 24-in. artery which could easily transport as much gasoline as then was being refined in this country, he would have been accused of having something more than the proverbial pipe dream. Petroleum geologists of that time may have discussed in the abstract the possibilities of finding oil more than 3 miles below the earth's surface, but they never expected that drillers would be able to find out whether oil was available at that depth.

It is certain that future trends will follow the same general pattern of the past. Progress will come through the solution of problems immediately at hand.

One of these is how to establish sound industrial relations. Many operators went to Chicago from refineries seized by the U. S. Navy. Until labor issues which precipitated this emergency action are definitely solved, the refinery division will mark time.

Refiners as a group have the task of converting wartime facilities to the production of peacetime products. The manufacturing arts of this industry, if freed from governmental and other restrictions, can move farther over the next 5 years than they did in the period between the two world wars.

The industry has new tools which greatly strengthen its approach to the problems of where and how to drill and the recovery of the oil after it is found. Operators now have the vital data around which new concepts in well spacing can be made effective.

"But what about atomic energy?" is a recent but already familiar question. Analysts within and outside the oil industry answered that at Chicago. As an oil competitor this much-discussed physical phenomenon occupies much the same position as other potential competitors of the past which either failed to materialize or became content with minor positions. This fact does not minimize the significance of a new destructive force in international relations. Here is a situation certain to be brought home to the oil business along with all other world-wide industries before another A.P.I. annual meeting is held.

It appears safe to hazard one 25-year prediction, and that is that petroleum will become truly global.

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Davies Corrects Misconceptions In Oil-Treaty Language

WASHINGTON.—Deputy Administrator Ralph K. Davies this week issued the following statement:

"Some of the industry advisers to Petroleum Administration for War have urged this office to correct certain misconceptions that have arisen as the result of statements that the text of the Anglo-American oil agreement was surreptitiously changed.

"These statements referred to the section of Article 7 defining the word 'country' which reads as follows:

"'The signatory governments agree:

"'C. That for the purpose of this article, the word "country" shall mean:

"'1. In relation to the Government of the United Kingdom of Great Britain and Northern Ireland, the United Kingdom, those British colonies, overseas territories, protectorates, protected states, and all mandated territories administered by that government, and

"'2. In relation to the Government of the United States of America, the continental United States, and all territory under the jurisdiction of the United States, lists of which, as of the date of this agreement, have been exchanged.'

"That is the exact wording desired by the American delegation and is the exact wording that was seen and approved by our six industry consultants.

"It is the exact wording of the treaty signed by the American and British delegations. It is the exact wording of the treaty given to the president and by him submitted to the U. S. Senate for its advice and consent to ratification if it approves.

"It is true that in the earlier draft of the treaty the first paragraph of the article read 'all British colonies' and that this was changed to read 'those British colonies.' But the important fact is that this change was made during the negotiations leading up to the final draft, which was signed.

"The purely grammatical change from 'all' to 'those' was made to express even more clearly the agreement that, for the purpose of the treaty, no territory should be considered as included as a part of either country unless it appeared in the lists. The change was made with the full knowledge and endorsement of the six industry consultants.

"Unfortunately, in cabling the text of the treaty to Washington so that the American press might have it at the same time as the British, the secretary of the American delegation transmitted a draft in which the change from 'all' to 'those' had not been made. This erroneous draft is the one that was distributed to the press and to many oil men in this country.

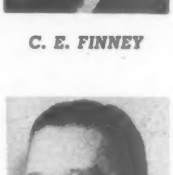
"Those who have charged that the change was made surreptitiously have attempted to make it appear that it constituted a 'trap' for the American oil industry because the British list does not include Burma and Kuwait.

"Of course, it is quite true that Burma and Kuwait are excluded. The American delegation and the industry consultants were unanimous in wanting them excluded from British 'domestic' territory for the very good reason that we wanted their commerce to be considered as in international trade."

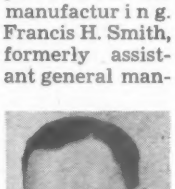
Promotions Announced by Standard of California

SAN FRANCISCO.—Three promotions in the manufacturing department are announced by Standard Oil Co. of California. Charles E. Finney, Jr., formerly general manager of the manufacturing department, has been made assistant vice president for manufacturing. Francis H. Smith, formerly assistant general manager of manufacturing, has been advanced to general manager. A. C. Moorhead, since 1943 assistant general manager of the manufacturing department, has been named personnel director of that department.

C. E. FINNEY



F. H. SMITH



A. C. MOORHEAD

Finney, a graduate of Cornell University with a degree of mechanical engineering, joined California Standard in 1919 at the Richmond, Calif., refinery. In 1928 he was appointed assistant superintendent of the refinery and later manager of the pressure - distillation department there. In 1931 Finney went to El Paso, Tex., as manager of the Pasotex refinery, operated by a subsidiary. Two years later he returned to California as manager of the Richmond plant. In 1933 he was transferred to the company's head office in San Francisco, where he became successively chairman of the manufacturing committee, assistant general manager of the manufacturing department, and in 1943, general manager of the department.

Smith began working for the company in 1913 at the El Segundo, Calif., refinery. Fifteen years later he was transferred to the Richmond refinery as superintendent, and in 1934 he became manager. In 1944 he was named assistant general manager of manufacturing, with headquarters in San Francisco.

Moorhead, a graduate of University of California in mechanical engineering, joined the company in 1917 at Richmond.

Texas to Join California in Submerged-Land Fight

AUSTIN. — Texas will stand beside California in the submerged land suit brought against that state by the U. S. attorney general in the federal Supreme Court.

"Whatever method is used to enter the case," said Grover Sellers, Texas attorney general, "This department will use all the resources at its command to represent the interests of Texas and combat every effort to deprive our school children of the rich heritage that lies beneath the tidal water of our shore line."

Resignations of 24 More From PAW Accepted

WASHINGTON.—Resignations of 24 more men from key positions in Petroleum Administration for War have been accepted by Ralph K. Davies, deputy administrator, who forecast complete liquidation of his agency by the end of the year.

Latham Succeeds Hunter On Compact Commission

AUSTIN.—Sidney Latham, of Dallas, attorney and vice president of Hunt Oil Co., has been named by Gov. Coke Stevenson as Texas representative on Interstate Oil Compact Commission, to succeed the late J. C. Hunter, who was vice chairman of the commission.

Strong Consultive Organization to Succeed PIWC Urged at A.P.I. Meeting

by H. Stanley Norman and Arch L. Foster

CHICAGO.—Formation of a strong consultive organization within the petroleum industry to take over the Government advisory functions handled during the war by the Petroleum Administration was advocated here last week as one of the highlights of the twenty-fifth annual meeting of American Petroleum Institute. The suggestion was made by Ralph K. Davies, deputy petroleum administrator, who paid high tribute to the industry for its wartime service record.

Approximately 2,700 oil men from all parts of the country registered at the A.P.I. meeting, ranking it with many of the prewar assemblies of the industry's largest trade association. A serious consideration of all pending and future problems characterized the response to well rounded general and technical sessions. Scores of technical committees started their conferences 3 days ahead of the official opening November 12 and continued work through the final day, November 15.

Directors of the A.P.I. stamped formal approval on the Anglo-American petroleum agreement and thus threw weight of this organization behind the proposed treaty.

Thirteen new members were elected to the A.P.I. board. They are: J. O. Donnell II, Ohio Oil Co.; Paul Stock, Yale Oil Corp.; R. B. Anderson, W. T. Waggoner estate; W. J. Violette, Standard Oil Co. (Kentucky); A. M. McKinney, National Supply Co.; J. L. Shakely, Jones & Laughlin Supply Co.; A. B. Judd, Republic Supply Co.; J. French Robinson, East Ohio Gas Co.; B. A. Hardey, I.P.A.A.; Ralph T. Zook, Sloan & Zook; James A. Dunn, Barnsdall Oil Co.; John R. Suman, Standard Oil Co. (N.J.), and Floyd Clinger, Pennsylvania Grade Crude Oil Association.

In advancing his argument for an oil-consultive organization to continue in an advisory capacity to Government on industry-wide problems, Davies pointed to the confusion which existed in 1941 when the national emergency was declared. He disclosed that about 32 government bureaus and agencies in Washington were concerned in one way or another with petroleum. The loosely knit and independent operations of the Government dealing with oil presented a basic problem of organization. Without PAW or a similar organization the industry would have been thwarted in hundreds of ways to the end that its war record would have been much less commendable.

Davies carefully avoided specific recommendation on the type of organization or its composition for continuing the advisory work in the postwar period. He was emphatic, however, in his insistence that such a group would be beneficial to the industry and to the national welfare.

He cited inability of Government to cope with private industry in holding together an organization with the technical knowledge which has become imperative in oil operations.

"If the United States Government is to deal with the rest of the world in an effective way," he said, "it must be well prepared and this can only result in two ways—by the provision of additional qualified staff, or through reliance upon a consultative organization provided by the oil industry. I favor strongly the latter," he continued, "first because it will be of a higher order since Government is not prepared to compete with industry for personnel, and, second, because that kind of arrangement best conforms to our American system of private enterprise and best insures against government encroachment."

Coordinative Function

Concerning the government organization for dealing with petroleum in the postwar era, Davies told oil men that the industry advisory group he proposed could do much in how the federal departments, agencies, and bureaus are coordinated to function most effectively. He warned that the 32 prewar agencies which had varied contacts with the oil industry would soon resume their independent operations unless some way is developed to concentrate these functions in a better qualified and more intelligent manner.

C. R. Smith, chairman, American Airlines, Inc., presented a discussion at the general session November 14, following Davies, reviewing the early struggle of air transportation. He criticized the railroads for their decadent policies in meeting requirements of the traveling and shipping public. Smith painted a bright future for air transport and, consequently, pointed out that the requirements for aviation fuel and lubricants will increase.

Dr. Virgil Jordan, president, National Industrial Conference board, said that current values on wages and work will change radically in the years ahead. He visualized an economic future when the big problem of industry will be to get its goods consumed and in the task of amusing the public. Lt. Gen. James H. Doolittle and Lt. Gen. Raymond S. McClain commended the oil industry for development of products which made military assignments of the air force and ground troops as favorable as possible. Doolittle was particularly fluent in his praise for the industry's success in supplying the aviation gasoline in quantities which enabled the United States Air Force to gain control of the air in every theater. At a press conference before addressing the A.P.I. delegates, Doolittle repeated excerpts from his testimony before the Senate committee advocating a unified command for U. S. military forces.

Vice Adm. Ben Moreell, chief of the bureau of yards and docks and officer in charge of Navy petroleum plant office, referred briefly to naval operation of struck petroleum refineries. He said the Navy wished to return these facilities as quickly as possible to private operation. He, too, pointed out that adequate petroleum supplies were the key to successful naval operations. He illustrated the importance of oil by reporting that underground storage facilities have been built by the Navy at Pearl Harbor capable of storing 6,000,000 bbl. of oil. Duplicate pumping facilities and lines to

Next Year's Meeting Scheduled for Chicago

The 1946 meeting of the American Petroleum Institute has been scheduled by the board of directors to be held November 11-15, at the Stevens Hotel, in Chicago.

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the storage area and to docks have been constructed to minimize the possibilities of another sneak attack.

Capt. B. W. Gillespie, executive officer, Navy petroleum plant office, described the difficulties of transporting equipment and maintaining personnel at the Point Barrow exploration operation in Alaska. He illustrated his remarks with a full-length movie which clearly emphasized the difficult terrain and operating conditions. He reported that exploration activity is to be turned over to private contractors in the near future to continue the search for commercial oil deposits in the Navy's Alaskan reserve.

The institute revived its dormant marketing division after a wartime interim of inactivity. E. V. Weber, president of Eureka Oil Co., and vice president of the marketing division, expressed pleasure at being permitted to make the work of the division one of the most important of the institute's work. It is understood that three regional marketing division meetings are scheduled for the 1946 activities, but dates and places for the meetings have not been announced.

Superfuels Multiply Engine Power

The famous Liberty engine of World War I has been succeeded by its counterpart the superengine of World War II of five times the comparative power because of the tremendous improvement in fuels, said Col. Donald L. Putt, deputy commanding general of Wright Field, Ohio. The Liberty had 1,650 cu. in. piston displacement, developed 420 hp. on fuel averaging an estimated 55-octane number. The American version of the 12-cylinder Rolls-Royce Merlin aircraft engine had 1,650 cu. in. displacement and turns up 2,000 hp., operating on a fuel with 115 lean mixture octane number, and of 145 rich mixture octane rating, he said. In five basic power plants used in this war all fuels employed were essentially hydrocarbon except that used in rockets.

Twenty-six men were sent to Europe following V-E Day, composing the Technical Oil Mission from the United States oil industry, according to A. E. Miller, secretary of the Technical Advisory Committee of the Petroleum Industry War Council. The Mission was under the direction of C. S. Snodgrass, foreign division director for PAW, and they brought back a great quantity of information on German oil developments, on 20 general subjects. This information, classified as confidential earlier, is now considered restricted and much of it has been circulated to interested companies, Miller said.

Commenting on the changed picture in distillate fuel oils as caused by the large-scale introduction of catalytic cracking, A. E. Pew, Jr., J. G. Hill, and J. R. Bates of Sun Oil Co. showed that:

1. More cracked fuel oil will be produced from heavier stocks by catalytic cracking than was made from the same sources by thermal cracking in earlier years, and the fuel will be of lower A.P.I. gravity.

2. Residual fuel output will be materially less because of the greater use of catalytic cracking and less of the thermal methods.

3. Recharging of once-cracked No. 2 fuel oil will produce an No. 2 fuel of even lower A.P.I. gravity. This will cause all future No. 2 fuel oil to be heavier than ever. Earlier investigators have found that from 863,000 bbl. of charge per day to catalytic crackers more than 50 per cent of the furnace oil produced will be cracked material. In the postwar period—we now have more than a million barrels per day of catalytic capacity—furnace will be almost entirely cracked material from these processes, these authors estimate. This catalytic distillate fuel, they say, is clean, stable, and noncorrosive to burner parts, with a higher B.t.u. per gallon. The No. 2 fuel oil of our postwar supply will have A.P.I. gravity, 28°-30°; 10 per cent distillation, 460° F.; 90 per cent distillation, 585° F., it was estimated.

Factors Controlling Oil Recovery

The discussion that followed the presentation of three papers on well spacing brought forth some reasonable conclusions. One is that it will probably be impossible to prove conclusively that well spacing makes little or no difference in ultimate reservoir recovery, from evidence derived from a study of the data on the past performance of a large number of oil fields. The evidence leans strongly in that direction, but, no field was ever operated in the way a scientific experiment is performed, namely, keeping all factors constant with the exception of one, allowing that to be a variable.

Vietti, Mullane, Thornton, and Van Everdingen state that a difference of opinion exists as to the effect of spacing on recovery of oil. A critical review of the information on the Mexia-Powell fault line fields show that these data cannot be derived, as suggested by others to derive such a formula to show this relationship. Differences in unit recoveries are small and are attributable to other effects than spacing, they believe. The derivation of formulas to calculate total recovery from spacing and production data in fields previously is incorrect, they said. Choice of well spacing should be based upon the principles which govern reservoir performance and not on empirical formulas proposed in the industry's earlier days, they believe.

In the course of analysis of field data to determine the relationship that exists between ultimate oil recovery and well spacing, R. C. Craze and S. E. Buckley, Humble Oil & Refining Co., found that the recovery from the fields studied is dependent on the oil viscosity, reservoir pressure decline, and formation permeabilities. Recovery is not dependent on well spacing, they said. Evaluation and elimination of the effects of these factors showed that these fields, having well spacing varying from 2.6 to 65.6 acres average, have ultimate recoveries entimely independent of that spacing.

Board Approves Reorganization Plans

CHICAGO. — Plans for the reorganization of American Petroleum Institute were approved by its board of directors at its 1945 annual meeting. Details of these plans include the decision to retain the home office of the institute at New York, but to arrange for an adequate organization at Washington, D. C., where key members of its staff will spend part of their time regularly.

All transportation activities of the institute will be consolidated into a new transportation division located at Washington, under a vice president for transportation. Executive control of the American Petroleum Industries Committee was transferred to the president of A.P.I. The title of executive vice president has been eliminated, as has all reference to it in the bylaws of the institute.

The specific authority of the president has been redefined, and provision has been made for the senior vice president to preside at meetings in the president's absence. Also, the authority of the 24-man executive committee has been redefined, and provision made that not more than one man per company can serve on this committee. Each general committee secretary is now to carry the title of "director."

A foreign department may be created by the president when in his opinion suitable conditions requiring it prevail. Creation of other new departments will be postponed until need for them is urged by the membership of the institute. The institute will enlarge public-relations activities by formulating and carrying out a systematic and comprehensive program in that field. Authorization was given also,

by the board, to continue to study and expand the functions and activities of the institute.

The officers of American Petroleum Institute elected for the ensuing year are as follows, most of them being reelected: President, W. R. Boyd, Jr.; George A. Hill, Houston, vice president for production; J. Howard Pew, Sun Oil Co., vice president for refining; E. V. Weber, Eureka Oil Co., vice president for marketing, and B. Brewster Jennings, Socony-Vacuum Oil Co. as vice president of the newly organized division of transportation. O. D. Donnell, The Ohio Oil Co., was reelected treasurer, and Lacey Walker, secretary.

Later it was announced by W. R. Boyd, Jr., president, that D. V. Stroop, formerly secretary of the marketing and refining divisions, in accordance with the power voted the president by the board of directors, had been appointed assistant to president. James E. Moss has been added to the institute staff as director of the transportation division.

Pipeliner's Club Formed At A.P.I. Meeting

CHICAGO.—Burt E. Hull, Texas Pipe Line Co., was elected president of the newly formed Pipeliner's Club during the A.P.I. meeting last week. A board of governors was elected, including Capt. W. R. Finney; Clark H. Kountz, Sinclair Refining Co.; N. C. McGowen, United Gas Pipe Line Co.; and Burt R. Bay, Northern Natural Gas Co. No activities were carried out during the meeting except the organization, but a banquet will be held during the 1946 meeting. The board of governors will formulate membership requirements and designate the length of service which will be required to qualify a member as "water boy," "tong man" or "collar pounder." These requirements will be submitted to all men designated by the board of governors as eligible.

H. H. Glen Elected Chief Of Equipment Group

CHICAGO.—Hugh H. Glen, Emsco Derrick & Equipment Co., Los Angeles, was elected here during the meeting of American Petroleum Institute as president of Petroleum Equipment Suppliers Association. Arden B. Judd, Republic Supply Co., Houston, was elected vice president; Wharton Weems, Houston, was reelected secretary of the association. Because of the difficulty of obtaining accommodations for meetings at the meeting of the institute, it was decided at this meeting to hold only a meeting of the association's board of directors.

Bombers With 10,000-Mile Cruising Range Near, Doolittle Tells A.P.I.

CHICAGO. — U. S. B-36 bombers, with an extreme cruising distance of 10,000 miles without refueling, will be in the air very soon, Lt. Gen. James H. Doolittle told the American Petroleum Institute meeting here November 14. These air giants were well under way when V-J Day came, he said, and indicated that they will be the most powerful air weapons in the world when they are in operation. No details of these planes were disclosed by Doolittle.

The "home front people" built a total of more than 300,000 airplanes during this war, Doolittle said, and praised highly the aid rendered the combat forces by the aeronautical and petroleum industries. The U. S. oil industry refined 86 per cent of the total quantity of aviation gasoline used by the United Nations, or 490 million barrels. Production peak was April 1945, when the whole United Nations air forces used 20 million barrels during the month, AAF using 12 million of that quantity. With the total amount of fuel obtained the Doolittle - commanded Eighth Air Force destroyed more than 30 fuel plants in Germany and Hitler-held Europe; the 15th Air Force destroyed most of those in Central Europe, the RAF of Britain destroyed 10 plants in the Ruhr Valley. The three forces dropped 200,000 tons of bombs in synthetic and other fuel plants, reducing production at one time to 7 per cent of normal.

The U. S. ended the war using aviation fuel which is termed 100-130, generally referred to as 100-octane-number fuel, he stated. At the same time we were using 100-150 fuel for special purposes. The first number in these expressions refers to the octane rating under lean-mixture conditions, the second number indicating the octane rating under rich-mixture conditions. A new fuel of 115-145 rating was about to be used by the AAF when the war ended, showing a higher antiknock rating under lean mixture or cruising operating conditions. It was intended for use in certain front-line combat planes and would have increased the performance of these craft considerably. Higher - quality fuels were under study and research at that time; Doolittle does not consider that the last-mentioned fuel is the last word in fuels for conventional engines—before jet propulsion takes over the powering of aircraft for military purposes.

Investigation of new components and new additives which will improve aviation fuels is a "must" for the petroleum industry, the speaker stated. Lean mixture or cruising-range performance of aviation fuels must be investigated and improved, especially. Using mostly kerosene thus far to fuel turbo jet and gas-turbine engines, we must develop further our knowledge of fuels for this purpose. Interceptor, fighter, and bomber aircraft will be powered largely by such jet units in future, Doolittle said, and British thermal units—heat content-per gallon will rule in great measure since space limitations will be critical in the fast-thinning wings and fuselage of aircraft. Doolittle holds out for an air force independent and coordinate with the Army and Navy, the whole three divisions being under a single national department.

25-Year Club Meets in Chicago

CHICAGO.—Under the direction of its president, Otto D. Donnell, The Ohio Oil Co., the sixth annual banquet of the 25-Year Club of the petroleum industry was held at the Casino Club here Tuesday, November 13. President Donnell served for 2 years instead of the usual 1-year tenure, since the institute did not meet in 1944 and this club meets during the period of the Institute's annual meeting.

This club is purely social in character and purpose, open to all members of the petroleum industry who have served for 25 years or more in the refining or marketing branches. Enrollment must be sponsored by a chief executive of a company or by one of the members of the club in good standing. Its officers include the new president, H. T. Ashton, elected for 1 year, a board of governors of five members chosen from the main oil districts of the United States. The new board includes H. D. Collier, Pacific Coast; Richard A. Wotowich, governor-at-large; J. Edgar Pew, Eastern Section; D. J. Moran, South Central and Rocky Mountains; and Henry M. Dawes, North Central area, with Frank Phillips, ex officio. The club includes about 325 members.

XUM

Rangely, One-Time Shallow Field, Now Rocky Mountains' Most Active Area

*by C. R. Thomas**

Substantial new oil reserves have been opened at Rangely, current "hotspot" in the Rocky Mountain area. The discoveries have led to the construction of a pipe-line outlet; much additional drilling is contemplated. C. R. Thomas of U.S.G.S. and author of the accompanying material, has maintained close connection with the development. One of the Journal's editors is now in the field collecting additional data for early publication.

THE Rangely oil and gas field, in Rio Blanco and Moffat counties near the northwest corner of Colorado, has been mapped by the U. S. Geological Survey to supply data to aid in the search for new oil reserves and also to facilitate the administration of federal oil and gas leasing laws on public lands in the field. The field was described by Gale[1] in 1908 and 1910, and by Heaton[2] in 1922.†

The field lies near the crest of the northwest-trending Rangely anticline. The southwest flank of the anticline has dips of 13° to 21°, and the northeast flank dips more gently. The exposed rocks near the crest of the anticline are broken by several northeast-trending normal faults and by numerous joints, some of which contain calcite veins. Of special interest is the fact that shallow oil occurrence in the field is controlled by fractured zones in the rocks near the calcite veins. Oil is obtained from approximately 30 wells in the Mancos shale of Cretaceous age and also from 13 wells in the Weber sandstone of Pennsylvanian age. The first well to the Weber sandstone was drilled in 1933 and placed on regular production in September 1943.

As rocks of Pennsylvanian age are oil bearing in several anticlines in Wyoming, the present production from the Weber sandstone has revived interest in deep drilling in the Rangely field. Other areas within the field, both in the Mancos shale and in beds at greater depth, appear to be favorable for further prospecting.

History of Drilling and Production

Oil was discovered in the Rangely field in 1902 in a well drilled on the east nose of the anticline in SW SW NE 33-2n-102w. This well yielded only 2 to 7 bbl. of oil a day from the Mancos shale at depths of 800 and 1,700 ft., and it was soon abandoned. According to Gale,[3] 12 wells were drilled in the field between 1902 and 1907. Following this period of preliminary exploration, drilling was intermittent until 1919, when significant production began with the completion of the 1 Emerald Oil Co. This well, which was in the SE NW 31-2n-102w, had an initial daily yield of 130 bbl. from the Mancos shale at a depth of 521 ft. Many shallow wells, whose initial daily yields ranged from a few barrels to more than 100 bbl., were completed in the Mancos shale between 1919 and 1943. Although many of these produced oil for a while and later abandoned, a total of 25 wells remained active at the end of 1943.

Most of the wells in the field were stopped in the Mancos shale, but a total of seven and possibly eight wells were drilled into the Dakota (?) sandstone. The first deep hole in the field was drilled in 1907 near the west quarter corner of 16-2n-102w. Its total depth is recorded as 3,655 ft. in some reports and as 3,810 ft. in others, and thus it may or may not have reached the Dakota (?) sandstone. Of the remaining deep wells, three in the S½ S½ Section 30, and one in the NW 31-2n-102w, all of which were drilled between 1924 and 1927, yielded gas from the Dakota (?) sandstone for a time, but the gas flow was soon drowned out by water in the sand. The maximum daily yield of the largest of these wells was 74,000,000 cu. ft. A well in SW 21-2n-102w, also encountered gas in the Dakota (?), but the amount of flow was not learned.

A deep well in the southeast corner of 24-2n-103w, penetrated the Dakota (?) sandstone, Morrison formation, Curtis formation, and part of the so-called Nugget sandstone, which includes the Entrada sandstone, Carmel formation, and Navajo sandstone of Baker, Dane, and Reeside.[4] According to available information the so-called Nugget sandstone yielded water, and several of the sands below the Mancos shale yielded small amounts of gas.

The California Co. 1 Raven well in NW SE 30-2n-102w, was drilled between 1931 and 1933 to a total depth of 7,173 ft. It penetrated all Mesozoic rocks below the Mancos shale, and extended approximately 1,500 ft. into rocks of Pennsylvanian age. The log of the well indicates that gas was encountered in a sand in the Morrison formation, and also in the so-called Nugget sandstone, but the amount was not determined. The well produced oil from beds in the Weber sandstone at depths of 5,704 to 6,320 ft. After yielding a total of about 8,000 bbl. of oil in 1933, it was shut in until September 1943, when it was again placed on production. During the early part of 1944 it yielded about 225 bbl. a day.

Production From Weber Sand

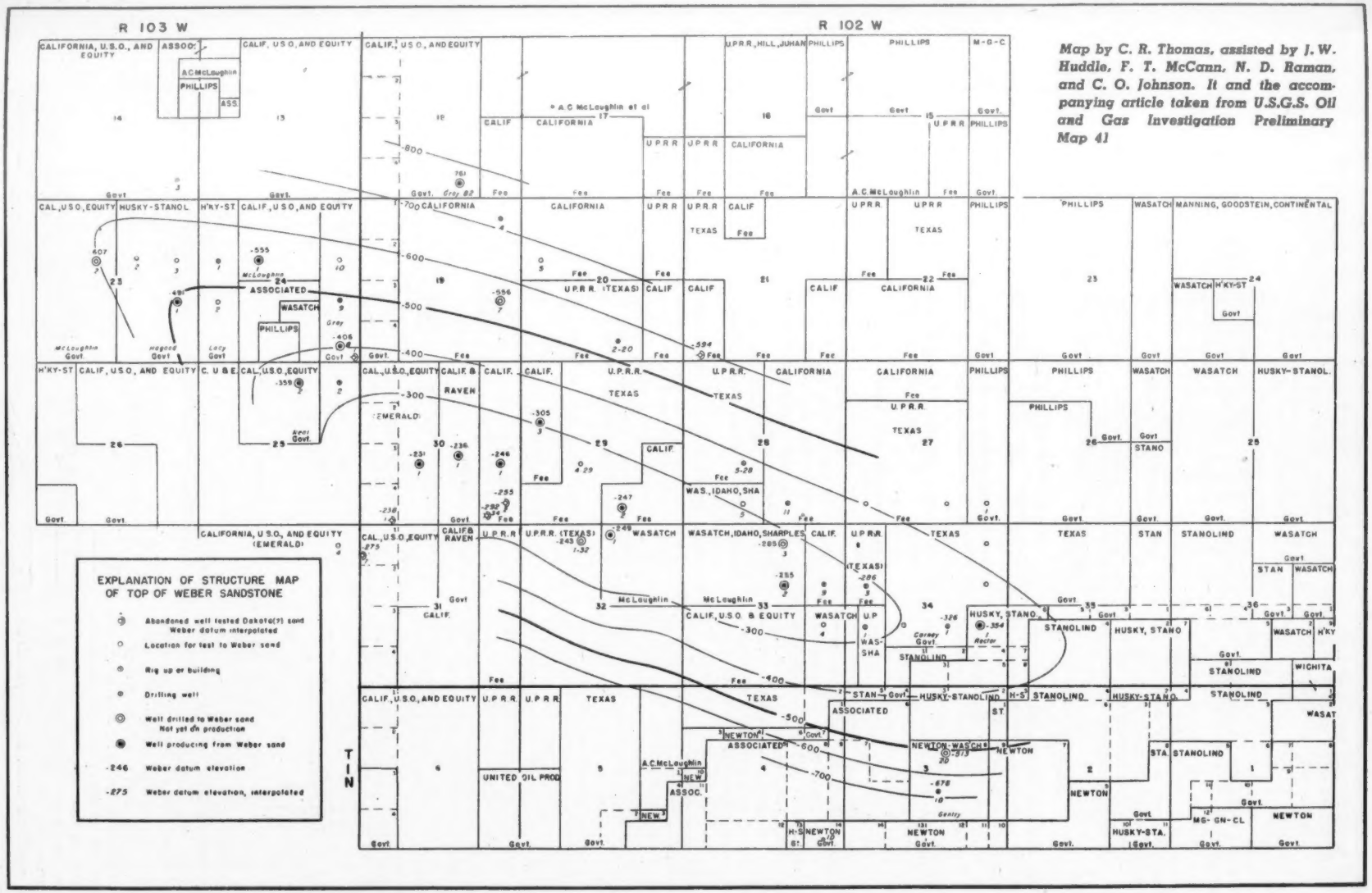
Since the reopening of the California Co. 1 Raven considerable deep drilling has been done. Up to July 23, 1945, 17 additional wells had reached the Weber sandstone, 13 of which were on production. Most of these wells have produced initially from 100 to 400 bbl. per day through chokes varying from ⅛ to ¼ in. Drill-stem tests have indicated pressures of from 2,200 to 2,300 lb. The gas-oil ratio is quite low, averaging from 300 to 350 cu. ft. per barrel of oil. The average cost per well is about $130,000 to $140,000, but some of the earlier wells cost much more.

Additional shallow drilling, after the publication of the first map (oil and gas investigations, preliminary map 7), has developed one small producer near the northeast corner of NW SW 29-2n-102w, and four good producers near the southeast corner of 28-2n-102w.

Between 1919 and 1938 the annual production of oil from the Rangely

*U. S. Geological Survey, Denver Field Office.

†A structure map of the exposed rocks was published in 1944 as Preliminary Map 7 of the U.S.G.S. oil and gas investigations series. The map was based on plane-table surveys and data from well cuttings examined microscopically. During the fall and winter of 1943-1944 the present structure map (contours drawn on the sandy limestone bed, "H," about 15 ft. above the contact between the Mesaverde formation and the Mancos shale) represents a partial revision of the earlier map and embodies the results of recent drilling (this map not presented here).


R 103 W
R 102 W
T 11 N
EXPLANATION OF STRUCTURE MAP OF TOP OF WEBER SANDSTONE
Abandoned well tested Dakota(?) sand Weber datum interpolated
Location for test to Weber sand
Rig up or building
Drilling well
Well drilled to Weber sand Not yet on production
Well producing from Weber sand
-246 Weber datum elevation
-275 Weber datum elevation, interpolated
Map by C. R. Thomas, assisted by J. W. Huddle, F. T. McCann, N. D. Raman, and C. O. Johnson. It and the accompanying article taken from U.S.G.S. Oil and Gas Investigation Preliminary Map 41

The important Weber sand, as to structure and development, is shown here. Productive area may be 21 sq. mi.

field ranged from 10,000 to almost 33,000 bbl.; in 1939 and 1940 it exceeded 100,000 bbl.; in 1941 it exceeded 200,000 bbl.; in 1942 and in 1943 it was slightly greater than 300,000 bbl.; in 1944 it was slightly less than 400,000 bbl.; and the production in 1945 through May was slightly more than 265,000 bbl.

The gravity of the oil from the Mancos shale is 42° A.P.I., and the sulfur content is less than 0.1 per cent, whereas the gravity of the oil from the Weber sandstone is 33°, and the sulfur content is 0.68 per cent.[6]

Geology

The Mancos shale and the overlying Mesaverde formation, both of Cretaceous age, are the only rock formations exposed at the surface in the Rangely field. The Dakota (?) sandstone, however, crops out a short distance northwest of the field along U. S. Highway 40. The uppermost 1,650 ft. of the Mancos shale, which has a total thickness of 4,850 ft., crops out on the axis of the anticline in the center of the mapped area. This part of the formation consists mainly of gray calcareous shale, containing relatively few thin beds of calcareous sandstone, sandy shale, and concretionary, lenticular, sandy limestones. The beds of sandstone increase in number near the top of the formation and form a transition zone between the Mancos shale and the overlying Mesaverde formation. Only the lower 1,000 ft., more or less, of the Mesaverde formation crops out in the area mapped. This part of the formation consists of interbedded, brown to light-brown sandstone and gray to yellow-brown shale. It contains, in addition, a few beds of carbonaceous shale, coaly shale, and coal.

The boundary between the Mancos shale and the Mesaverde formation lies at the base of the lowest prominent sandstone in the transition zone, as shown in the columnar section. For convenience in mapping, however, a more persistent bed of sandy limestone, which lies about 15 ft. above the base of the Mesaverde, has been used as a datum on which to draw structure contours. This bed, ranging from 1 to 10 ft. in thickness, generally averages 3 ft. in thickness, and is designated bed "H" on the map† and columnar section. Several other key beds in the Mancos shale and in the Mesaverde formation were traced during the plane-table survey. These beds are described in the columnar section, and outcrops of several of the most prominent are shown on the map.† Of these beds, L and M deserve particular mention because they furnish structural control near the crest of the anticline.

†Ibid.

Top of Rangely Anticline Comprises Raven Park Basin

The surface expression of the Rangely anticline is typical of Rocky Mountain folds in that the crest is marked by a topographic basin. This basin, known locally as Raven Park, is formed in the soft Mancos shale, and is surrounded by a high rim rock made up of resistant sandstone members in the lower part of the Mesaverde formation. The anticline, trending west on the east end and northwest on the west end, is 20 miles long and 8 miles wide. The lowest closed contour line on

DESCRIPTION OF KEY BEDS

A—Thin-bedded, light brown sandstone, 10 ft. thick

B—Brown limey sandstone, 1 ft. thick, underlain by 10 ft. of massive brown sandstone

C—Brown limey sandstone, 1 ft. thick, underlain by 5 ft. of massive brown sandstone

D—Hard, bench-forming sandstone, 2 ft. thick

E—Massive, soft, yellow sandstone, 25 ft. thick

F—Thin, brown, lenticular, sandy limestone, 1 ft. thick, underlain by 1 ft. brown fissile sandstone

G—Soft, massive, brown sandstone, 35 ft. thick, locally contains large spherical concretions

H—Brown, blocky, lenticular, sandy limestone, 1 to 10, but generally 3 ft. thick

I—Brown, lenticular, sandy limestone, 1 ft. thick, underlain by 15 ft. of thin-bedded brown sandstone

J—Brown, lenticular, sandy limestone, 1 ft. thick

K—Brown, lenticular, sandy limestone, 1 ft. thick, underlain by 15 ft. of dark gray shale and sandy shale

L and M—Thin-bedded yellow sandstone and yellow sandy shale

N and O—Very thin dark-gray to black shaly sandstone

EXPLANATION OF COLUMNAR SECTION

Interbedded sandstone and shale, and sandy shale

Sandstone

Shale

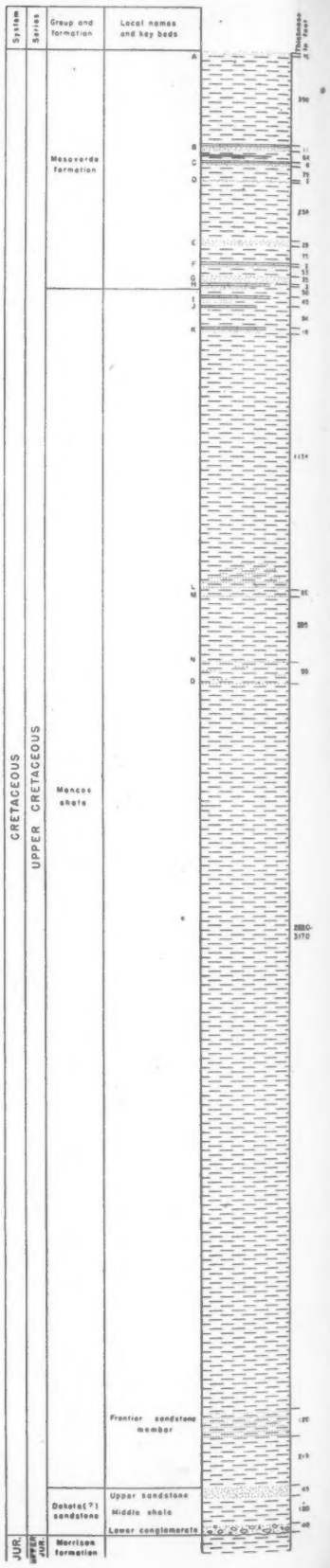
Thin bedded limestone

Conglomerate

Dirty coal and coaly shale

Unconformity

COLUMNAR SECTION OF EXPOSED ROCKS



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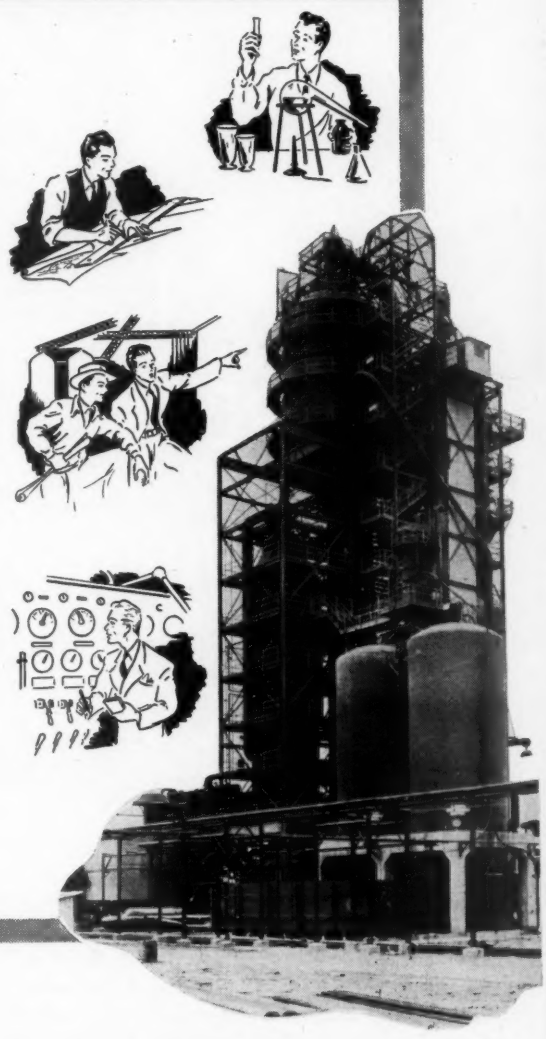

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bed "H" embraces an area of approximately 100 sq. miles and indicates structural closure of more than 1,900 ft. The dips of the beds on the southwest flank of the anticline increase from 13° near the axis to 21° at a distance of 1½ miles south of the crest; on the northeast flank the dips average 6°. The positions of the structure contour lines are controlled by many plane-table elevations and by dip and strike observations on key beds throughout the field. Near the crest of the anticline, where no key beds occur in the Mancos shale, the positions of the contour lines are based on dip and strike readings, supplemented by subsurface data obtained by examination of the well records.

Several short normal faults trending northeast and one trending northwest cut the basal rocks of the Mesaverde formation low on the southeastern flank of the anticline. The rocks are dropped on the southeast side of all faults except two—the westernmost of the northeast-trending faults, where the downthrow is on the northwest side, and the northwest-trending fault, where the downthrow is on the south side. On most faults the vertical displacement is less than 100 ft., but on one in 11-1n-102w, the vertical displacement is approximately 300 ft. The fault having the greatest lateral extent is low on the northwest nose of the anticline. It trends northeastward across the axis and northeastern flank of the anticline and may extend several miles northeast of the area mapped.

Character of Shallow Oil Production

One of the most striking features of the Rangely anticline is the association of oil with calcite veins in the Mancos shale. (The outcrops of many of these veins, which occupy joints in the shale, are shown on the map,† and others undoubtedly are present beneath the mantle of alluvium and terrace gravel that covers much of Raven Park.) The veins are most abundant near the crest of the anticline where folding was most intense. They generally mark strong zones of fracture, and strike northeastward parallel to most of the faults and joint cracks. The oil that is found at shallow depths in the Mancos shale appears to be in porous parts of these veins or in crevices in the fractured shale near the veins. For this reason the dip of the veins should be taken into consideration in planning well locations for oil in the Mancos shale.

Inasmuch as most of fault planes dip eastward, it is to be expected that the dip of the calcite-filled joints is in the same direction. The few observations that could be made in the field do not bear out this expectation, but the results probably are not conclusive. The calcite vein that crops out near the southeast corner of 33-2n-102w, appears to dip 85° SE° at the surface. The vein crossing the east line of the NE SE 33-2n-102w, has been prospected by two holes, both about 100 ft. deep, one on each side of the vein at a distance of 2 ft. from the vein. The fact that neither hole intersected the vein suggests either that it dies out at depth or that it is vertical. Two parallel veins that crop out near the center of the N½ NW 5-1n-102w, appear to dip northwest at an angle of about 60°. The most conclusive field evidence was obtained in 31-2n-102w, where the operators are said to have determined, by drilling many shallow wells, that the calcite veins in that locality dip northwest at steep angles.

Log of Wells 7,173 Ft. Deep

The most complete record of the subsurface rocks in the Rangely field is supplied by the log of the California Co. 1 Raven well, which is given in Table 1.

Conclusions and Recommendations

To date no water has been found in the Weber sand, and no data have been observed for satisfactorily limiting the pool in that sand.

A. Dakota and Morrison sands.— Recent drilling in the field has opened the possibilities for new productive horizons. The Wasatch McLaughlin 1 well, NW cor. NW NE 32-2n-102w, cored oil-saturated sand in the top of the Dakota (?) sandstone. The Texas Union Pacific 1-32 well, C NE NW 32-2n-102w, found Morrison sand between 3,228 and 3,248 ft. This sand on a drill-stem test showed some gas and oil of 33.4° (Baumé) estimated at 30 bbl. per hour. It is thought that any Morrison sand production, when developed, will be irregular, for these sands, where they are exposed on the surface, are extremely lenticular.

B. Deeper possibilities. — Though no formation below the upper member of the Morgan formation has been tested in the field, still older sedimentary rocks should exist which have distinct possibilities. It is impossible to make accurate estimates of the thickness of these rocks because of insufficient data, but there should be 1,000 or more feet of Pennsylvanian rocks and 500 ft. of Mississippian and Devonian rocks as yet untested. The lower clastic member of the Morgan formation, which consists of fine to medium-grained porous sandstones and black carbonaceous shale with a few thin-bedded black limestones, offer distinct possibilities in that it contains both possible reservoir rocks and possible source rocks.

TABLE 1—RECORD OF CALIFORNIA OIL CO. 1 RAVEN, NW SE 30-2n-102w

	Formation—	Description	Thickness (ft.)	Depth (ft.)
	Mancos shale	Gray to dark-gray shale, grading downward to black calcareous shale. Contains a few thin beds of fine-grained sandstone and siltstone	2,970	2,970
	Dakota (?) sandstone	Fine-grained gray sandstone interbedded with gray and greenish gray shale	280	3,250
	Morrison formation	Green and varicolored shale, white sandy limestone, and limy sandstone	670	3,920
	Curtis formation	Dense, gray, limy shale; dense sandy limestone; and very fine grained, dark-gray, calcareous, glauconitic sandstone	90	4,010
So-called Nugget sandstone	Entrada sandstone	Light-buff, friable, calcareous sandstone, containing frosted and rounded grains	130	4,140
	Carmel formation	Red to brown sandy shale; dark-gray, fissile limy shale; and very fine grained, dark-gray calcareous, buff sandstone	70	4,210
	Navajo sandstone	Salmon-pink, very fine to fine-grained sandstone containing rounded and froster grains	480	4,690
	Triassic (undifferentiated)	Interbedded red, gray, and green shale; gray to brown, very fine grained sandstone; containing a few thin beds of gypsum	820	5,510
	Park City formation	White, fissile shale, and red-brown shale, containing thin beds of hard limestone and very fine to fine-grained gray and light-yellowish calcareous sandstone	130	5,640
	Weber sandstone	Upper 300 ft. consists of fine to very fine grained, gray to buff sandstone containing three beds, 10 to 15 ft. thick, of shaly, micaceous red sandstone; parts of the entire sequence are limy. Lower 900 ft. is similar to top 300 ft. with increase in red beds downward. Several oil-bearing beds which are mainly buff colored occur between 5,704 and 6,320 ft.	1,225	6,865
	Pennsylvanian, upper member of Morgan formation	Very fine grained, white to pink calcareous sandstone; gray and red shale; and beds of dense limestone	308	7,173

The Madison limestone has produced oil in other areas and no sound reason exists to preclude the possibilities of its producing oil here. Although the character and thickness of these older Paleozoic rocks are not known, one or more test wells located near the top of the anticline would seem warranted to test their petroleum possibilities.

C. Weber may cover 21 sq. miles. In the Raven No. 1 well, which is near the crest of the anticline, oil occurs in sandstone beds distributed through a vertical zone of about 600 ft. in the Weber sandstone. This suggests that these beds are oil bearing throughout the entire area underlain by the upper 600 ft. of closure. Thus, the 6,600-ft. contour line, which is only a little more than 600 ft. below the crest of the anticline, encloses an area of approximately 21 sq. miles that is favorable for prospecting. It is possible, moreover, that the Weber sands are oil bearing below the position of the 6,600-ft. contour line. It should be noted in this connection that the oil-water contact in the oil-bearing zone might be expected to be somewhat lower on the southwest or basinward flank of the anticline than on the northeast or mountainward flank.

D. Trends of calcite veins.—The occurrence of oil associated with joints and calcite veins at shallow depth at several widely separated places on the anticline suggests that many other places containing calcite veins should be prospected. Moreover, the present oil-producing areas may possibly be extended along the trends of the calcite veins. A few of the places that appear to be worthy of prospecting are listed below:

1. The area near the group of closely spaced calcite veins in the SE NE SE 31-2n-102w.

2. The area near the calcite veins in the NW SW 31-2n-102w.

3. The zone along the longest calcite veins in the N½ S½ 31-2n-102w.

4. The area near the short, closely spaced veins at the center of the north line of the NE NW 32-2n-102w.

5. The area extending northeast and southwest from the SE cor. 33-2n-102w.

6. The northeast-trending zone between the producing area in NE 31-2n-102w, and the two closely spaced calcite veins in SW SW 29-2n-102w.

7. The zone northeast and southwest of the producing wells along the two parallel calcite veins that cross Section 33 and extend into SE 32-2n-102w.

8. A narrow belt between the abandoned oil producer near the SE cor. Section 24 and the abandoned oil producers near the C of E½ 25-2n-103w. It is noteworthy that the deep hole near the SE cor. Section 24 lost circulation at a depth of 1,700 ft. in the Mancos shale, which indicates the presence of crevices or very porous rock.

Pertinent Data Related to Drilling

The Rangely area is sparsely settled and is not served by any railroad. Rangely, a village of about 200 persons, most of whom are oil workers, and three oil company camps are the only settlements within the mapped area. A large group of prefabricated houses is being erected at Wiley's Resort but most of the workers live in Vernal, Utah.

Most of the equipment for drilling is transported 105 miles by truck from Craig, the terminus of the Denver & Salt Lake Railway. Most of the oil produced has been transported 215 miles by truck to refineries in Salt Lake City, but the completion of the pipe line will eliminate this haul.

Water for deep drilling is pumped from White River; water for shallow drilling and for camp use is obtained from shallow earthen reservoirs; and water for domestic use is hauled by truck from Wiley's Resort on U. S. Highway 40, near the north margin of the area mapped.

Fuel for drilling is supplied in part by oil produced in the field, and in part by butane trucked into the area. In the early days of drilling, coal mined about 10 miles east of Rangely was used in the rig boilers.

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Mid-Continent Producers Favor Higher Prices

DALLAS.—A poll conducted by Independent Petroleum Association of Texas shows that 10 of 17 major oil companies questioned favor higher prices for crude at the well in the Mid-Continent region. D. Harold Byrd, president of the association, said the 10 favored correspondingly higher prices for products. Two companies withheld their views. Five gave no answers.

Favoring price increases were Magnolia Petroleum Co., Humble Oil & Refining Co., The Texas Co., Standard Oil Co. of New Jersey, Standard Oil Co. of Indiana, Pure Oil Co., Continental Oil Co., Phillips Petroleum Co., Cities Service Oil Co. and Socony-Vacuum Oil Co., Inc.

DEATHS

Col. John L. Haynes, 69, formerly president of Haynes Drilling Co. and vice president of Haynes Oil Corp., died November 16 at Spring Hill, Tenn. Colonel Haynes was active in the oil and gas business in Shreveport until 1939, when he retired and went back to his native state.

Clinton F. Wood, 50, Tulsa, southern division auditor, retail sales, for Mid-Continent Petroleum Corp., died November 18 near Tishomingo, Okla., from stoppage of the windpipe, result of a swelling caused by a wasp sting suffered a few hours before, while hunting.

C. Edwin Young, 85, at the time of his retirement in 1922 manager of the East Coast lubricating department of Standard Oil Co. of New Jersey, died November 16 in Chatham, N. J. He was in the company's service 40 years. He was a director of Fidelity Union Trust Co., Newark, N. J., until his death.

William K. Hall, 50, general counsel and director of Texas-Pacific Coal & Oil Co., died November 13 in Fort Worth. Hall, who attended University of Texas and South Texas School of Law, was on the legal staff of The Texas Co. in Houston for 13 years before going to Fort Worth in 1939.

Lawrence A. McVey, 35, executive assistant to the president of Intava, Ltd., died November 11 at Rye, N. Y. For 2 years he served as assistant aviation officer for Petroleum Administration for War in Washington.

William F. Burdell, 87, formerly associated with important oil and gas activities in Ohio, died November 10 in Columbus. With Beman C. Dawes, brother of former Vice President Charles G. Dawes, Burdell organized Ohio Cities Gas Co., which later became Pure Oil Co. In recent years his interests had been confined largely to banking.

William F. Clark, 69, one of The Texas Co.'s first scouts in Oklahoma, died November 13 in Tulsa. After leaving that company Clark was employed by Cities Service Co. and later by Phillips Petroleum Co. as landman in Bartlesville.

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Diamonds are a natural form of carbon and, while brittle, are the hardest known substance, rating 10 on the hardness scale as compared with 9 for carborundum. In oxygen or air diamonds burn at about 850° C., but unexposed can be heated much higher. In an electric arc they are converted to graphite at 3,600° C. The diamond proper is of gem quality. The bort is a poorly crystalized diamond of dark color. Another form, carbonado or black diamonds, has no cleavage. These latter types and small off-color diamonds of the gem variety are used in industry in large quantities; in fact, more by weight than true diamonds for gem purposes. For industrial applications, however, modern hard-faced metals approach the diamond in hardness, and furthermore have many exclusive features as regards fusibility, ease of application, sizing, ductility, replaceability, etc.

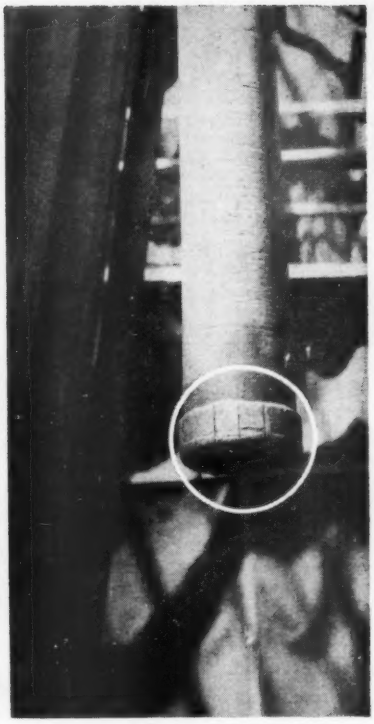
by Kenneth B. Barnes

DURING the last few months experimental coring of oil-productive limestones and dolomites has been done with diamond-faced core bits at four wells, with the recoveries being 83.8 per cent of 57 ft. cored, 96.5 per cent of 347.5 ft., 81.1 per cent of 60 ft., and 97.5 per cent of 40.5 ft. Furthermore, the wells all were in "hard to core" formations and territory. Corresponding to the aforegoing recoveries, the first two wells were in the Hunton lime, West Edmond pool, central Oklahoma, at 7,300 ft., the third in the Arbuckle dolomite, Ryan pool, western Kansas, at 3,700 ft., and the fourth in the Clearfork lime, Drinkard pool, southeastern New Mexico, at 7,000 ft., total depth.

Such coring accomplishments are news, since one bugaboo for many limestone and dolomite pools is in coring pay sections where core recoveries in the range of only 10 to 50 per cent of the footages cut quite often are the rule rather than the exception. Recoveries in this range, however, are not universal in all such formations; for example, in one Michigan pool approximately 100 ft. of Dundee lime have been cored in each of many wells, using standard rotary coring equipment, with the recovery ordinarily running 90 per cent or better.

Coring of limestones and dolomites, in the first place, involves so many variables that it is dangerous to generalize on the subject and it is necessary to treat the matter practically from well to well and step by step to avoid contradictions and erroneous conclusions. Basically, this arises from the erratic character of the formations as regards porosity, permeability, compressive and tensile strength, competency, and other such physical factors. While many limestone formations will core perfectly in their harder and denser parts, the porous and productive sections may be so fragile and incompetent as to be able to withstand very little weight and practically no "tearing" action in the cutting of the core itself. Light weights on the core cutter head and a scraping action in cutting are desirable in the soft sections. One or another, or all of the coring procedures, barrels, and drilling tools, which give good results in one instance, may not fit conditions some place else.

Another way of putting it is that the "experimental factor" is important if the changes made help in the right direction. One can, although not very properly, argue, because of their erratic nature, as to why limestones and dolomites should be cored at all. Answers to this are, first, that core recoveries as a whole are now getting much higher than they were a few years ago, both because of bet-



Discarded brake lining or tin is placed over the drill-pipe racking platform to prevent wooden splinters from getting inside the string and creating a "block" in the core barrel. Top of the barrel streamlines to the drill pipe. On the "business" or cutting end there is little to see but the short metal matrix and the diamonds

ter equipment and supervision, and second, most engineers and geologists feel that useful reservoir information can be obtained from any core taken within the possible oil-productive section. It also naturally follows that the more the core recovery, the more the information for geological and engineering analysis.

To review the four diamond coring tests, origination was in the West Edmond pool where some of the operators wished to core one test well to obtain, if possible, 100 per cent recovery. Recovery of the cores without any appreciable loss was the primary objective, without undue consideration as to cost, amount of trouble, necessity of special equipment, etc. Previous coring there had obtained about 50 per cent recovery as a whole (in one set of 16 wells, of 697 ft. cored, the recovery was 52.7 per cent).

In the first coring job 10 operators joined together in defraying the expenses of the coring. The firm of Drilling & Service, Ltd., Dallas, was engaged to supervise the actual coring during the time the cutter head was on bottom, to supply the core barrel, and to handle the diamond-bit brokerage..

In getting started on the initial test, in the first two 5-ft. cores taken the recovery was only 48 per cent, but in the following 45.5 ft. 92 per cent was obtained, and the over-all average for 57 ft. was 83.8 per cent. These results were considered satisfactory and detailed core analyses were made to complete the project. Encouraged by the first test, one of the participating companies decided to core another well in the pool in the same manner. A much greater footage was cored and even better recoveries obtained. The company next tried the diamond coring in one well each in Kansas and New Mexico, and again, as already mentioned, higher recoveries than ordinary were achieved.

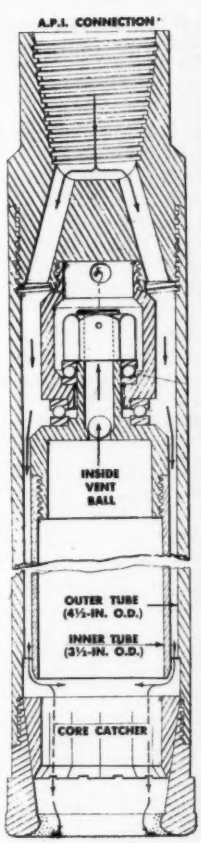
Before these experiments, very little, if any, work along such lines had been done at such deep depths without the use of an hydraulic drill pipe feeding mechanism. In the tests at hand, however, regular medium weight rotary rigs were used and the only special equipment employed was the diamond-faced cutter heads, a small capacity pump to give low circulation rates, and for the first well where tubing was used for the coring string, a small independently driven rotary table. The core barrel which was used can hardly be termed a special item since its general design was not greatly different from some other barrels already developed. Keeping in mind that the coring techniques were determined at the specific well, following are pertinent details concerning each of the four operations:

1. West Edmond: 57 Ft. Cored. 83.8 Per Cent Recovery

Before coring, 7-in. casing was cemented at 6,878 ft. The mud was conditioned to a viscosity of 44 with a weight of 9.1 to 9.6 lb. and a filtrate loss of 15.8 cc. in 30 minutes. A Guiberson Type H drill head and rotary table were secured to the top of the casing and driven by V-belts from a 125-hp. multicylinder engine. A 4½ by 6-in. duplex power pump turned by a 15-hp. multicylinder en-

Left, below: The inner barrel is suspended on a hollow spindle, through which fluid may escape as it is displaced by the incoming core. A ball check prevents the pumped fluid from impinging on top the incoming core. Two sets of ball bearings on the spindle allow the inner barrel to float and take vertical thrust

Right, below: Some of the coring recovered fairly long "solid" lengths, as shown by these 6 and 7-ft. cores standing in the laboratory preparatory to analysis



gine was used for circulation. Pump pressure ranged from 175 to 300 psi., averaged 221 over all of the work.

Four lines were strung to the traveling block. Two-and-one-half-inch upset tubing was used for the coring string. Approximately 2,000 lb. of drill collar and subs were used above the barrel. It was first believed that about 1,500 lb. should be carried on the core head; however, a few feet were cored here and there using weights as high as 10,000 to 12,000 lb. Average weight carried for the 57 ft. was 6,781 lb.

Bit number	Coring interval From	To
1	6,947 ft.	6,948 ft.
2	6,948 ft.	6,948½ ft.
3	6,954 ft.	6,959 ft.
4	6,960 ft.	7,009 ft.
5	7,009 ft.	7,065 ft.
6	7,065 ft.	7,226 ft.
7	7,226 ft.	7,284 ft.
8	7,284 ft.	7,301 ft.

Pumping rate of about 35 gal. per minute was used in the coring after the regular rig pump had broken circulation. Rotary table was first run at speeds of 250 to 400 r.p.m., but later this was reduced to about 200. Over-all average was 199.

Core No. 1—Rotary speed was 250 r.p.m. Some difficulty was had in maintaining an even weight. The first 3 ft. cut at 26 minutes per foot with a weight on the core head of 1,500 lb. For the next 2 ft. the weight was increased to 4,000 lb. and the time was 8 minutes per foot. Recovery was only 35 per cent.

Core No. 2—5 ft. were cored; 2,000 lb. weight was used for the first 2 ft. and then gradually increased to 5,000 lb.; average time was 5½ minutes per foot; recovery was 61.6 per cent.

Core No. 3—Weight averaged 7,300 lb., table speed 180 r.p.m., average time 5 minutes per foot. Of the 10-ft. section 90 per cent was recovered.

Core No. 4—Same operating conditions as before, time 4.7 minutes per foot, 85 per cent recovery of 15 ft. cut.

Core No. 5—Same operating conditions, time 6.5 minutes per foot, 100 per cent recovery for 10 ft.

Core No. 6—Weight averaged 8,167 lb., table 186 r.p.m., time 5.1 minutes per foot, 95 per cent recovery of 12-ft. interval.

No reaming was done while coring the 57-ft. interval.

2. West Edmond: 347.5 Ft. Cored, 96.5 Per Cent Recovery

The 7-in. production string was cemented at 6,947 ft. In the first run 1 ft. was cored. Recovery was 100 per cent and consisted of chert with some lime. The chert wore away the entire core bit and 2 in. of the barrel. The second core was taken with a new barrel and required 3 hours to penetrate 6 in. before a bearing failed in the core barrel and the outer tube cut in two. After recovering the fish and cleaning up the hole, the remaining coring proceeded uneventfully. Five additional heads cored the next 341 ft. The diamond bit record was:

Footage cored	Reason for changing
1 ft.	chert
½ ft.	chert and barrel failure
5 ft.	junk in hole pulled crown loose
49 ft.	
56 ft.	
161 ft.	damaged in removing
58 ft.	rolling fragment damaged
17 ft.	chert

On this well table speeds were 175 to 190 r.p.m. A roller-bearing kelly bushing was used to obtain smooth feeds. An absolutely straight kelly was found to be desirable to reduce swinging of the blocks and hook at the high speeds. Smooth feeding brakes on the draw works and a vernier-type weight indicator were essential items. Mud returns during the coring were diverted through a 2-in. connection to the flow line so they would be visible from the derrick floor, and coring discontinued immediately if returns stopped. While coring, the circulation rate was held between 20 and 40 g.p.m., and higher than normal mud viscosities used to maintain a clean hole. Weights on the bit were 3,000 to 5,000 lb. Six lines were strung to the crown block.

The operation took 30 days of continuous coring. The procedure, while very successful from a recovery standpoint, achieving the goal of practically no core losses, necessarily was expensive both because of the rig time required and the high cost of the diamond heads.

3. Ryan Pool (W. Kan.): 60 Ft. Cored, 81.1 Per Cent Recovery

After cementing 7 in. o.d. at 3,656 ft., diamond coring of the Arbuckle dolomite was commenced at 3,665 ft. Recovery was 100 per cent for the first 2-ft. run. Three-and-one-half-inch drill pipe and a 3-in. kelly were used.

Cores 2 to 8 proceeded with very good recoveries:

No.	Cored From	To	Recovered Feet	Per cent	Cumulative Cored	Recv.	Per cent
2	3,667	3,670	3.0	100	3	3	100
3	3,670	3,675	5.17	103.4	8	8.17	102
4	3,675	3,680	4.92	98.4	13	13.09	101
5	3,680	3,685	5.17	103.4	18	18.26	101
6	3,685	3,690	5.00	100	23	23.26	101
7	3,690	3,695	4.58	91.6	28	27.84	99.5
8	3,695	3,696.67	1.58	94.7	29.67	29.42	99.4

The greater than 100 per cent recoveries merely mean that while full recovery was had, the depth measurements, marked on the kelly, were not made with precisely the same weight on the bit each time, hence with the drill pipe being in the same degree of compression, and hence of exactly the same length below the kelly.

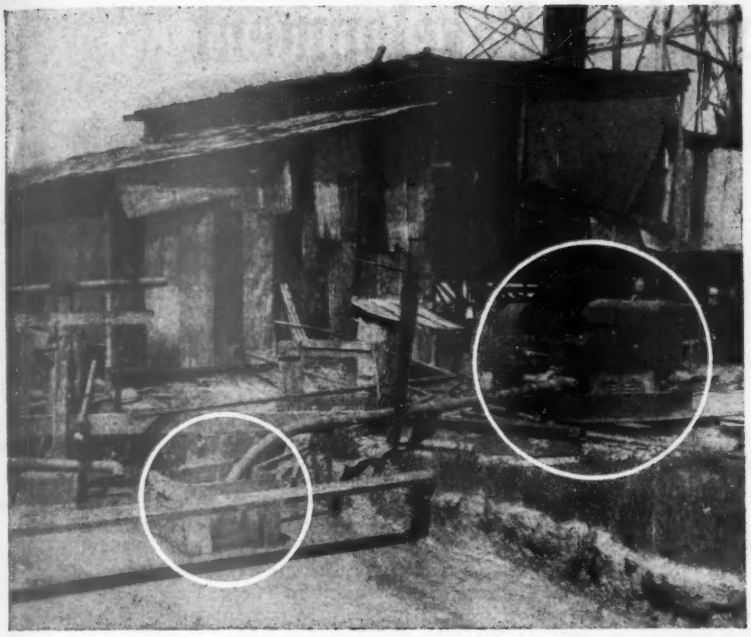
In this well it was anticipated that some chert would be encountered. To core the chert a special bit was constructed which had two layers of diamonds, one over the other, so that after one layer had been broken or worn off, coring could be continued with the second layer of diamonds exposed. In the eighth core (see table below), after 1 ft. 8 in. had been cored, chert was encountered which wore out the diamond cutter head, and accordingly the special double-layer head was used on the next run. This head, however, was the only one at the well and unfortunately it was damaged without receiving an actual test.

The next run with a diamond head made only 3 in. in 37 minutes and came out stripped of diamonds on the inside. Two inches of black cherty lime were recovered. A rock bit was used in drilling 1 ft. 1 in. in 30 minutes. A diamond-core head made 2.5 ft. and recovered 100 per cent before being cut out by chert.

Another diamond-core bit was run after the hole had been drilled 1 ft. deeper and recovered 2 ft. 10 in. of a 3-ft. run before failing. Again diamonds had been lost on the inside edge. This resulted in oversize cores being cut which shut off mud circulation through the barrel. On this run a different design of barrel had been used which had the core catcher placed in the inner barrel. This location permitted the bottom of the inner barrel to be placed very close to the cutting edge of the bit, and was an improvement in that it prevented the possibility of small fragments of rock lodging behind the core catcher and binding it to the outer barrel. The placing of the catcher in the floating inner barrel was intended to eliminate the infrequent instances of the catcher being frozen to the cutter head, rotating with it, and tearing up the incoming core.

On the next run the recovery was all but 5 in. of the 5 ft. 10 in. cut. This interval contained no cherty material.

In one of the later cores taken, 4 ft. 2 in. of dolomite with considerable chert were recovered out of a 5 ft. run, and approximately half of the diamonds were missing from inside of the diamond head. It was felt that the continual reaming of the hole between cores was preventing the



During the coring an auxiliary pump (right circle) of about 10 per cent the regular rig slush-pump capacity was used to give low circulation rates. A "must," because of the small passages in core barrel used, is the exclusion of foreign substances from the mud. Left circle shows screen box enclosure around the pump suction

development of sufficient rathole to stabilize the core barrel and that besides the chert, the losing of the inside diamonds thus was due to the top of the core barrel gyrating in the 6¼-in. hole, inducing unusual wear on the inside diamonds. Changes to alleviate this were considered and put into use on the next coring job.

In summary, the operation resulted in a core recovery of 81.1 per cent, practically double that which had been experienced before in the pool.

4. Drinkard Pool (N. Mex.): 40.5 Ft. Cored, 97.5 Per Cent Recovery

This coring job was different from the preceding tests in that there were 4,000 ft. of open hole present, in contrast to coring immediately below the casing shoe; also 4½-in. o.d. drill pipe was used and the drilled hole was 8¾ in. The diamond coring started at 6,926 ft.

In the first run, 6 in. had been cut when the draw-works brakes, which could not be slipped minutely and smoothly, skidded and threw excessive weight on the core bit, separating and damaging it.

The second diamond head made no progress and when pulled was found to be worn perfectly smooth. All the diamonds were gone and flakes of iron were embedded in the sides of the head. This, together with other previous experience, shows that in diamond coring even very small particles of steel junk or diamonds in the hole can cause serious difficulties—much more so than with conventional coring equipment. This point was further illustrated in the third core taken, after the hole had been drilled from 6,929 to 6,936 ft. The core head did not cut and when pulled, the core barrel was found cut off immediately above the bit. Very probably one or more of the lost diamonds from the first run had stuck in the wall of the hole and acted as a lathe cutting tool. Two runs with an 8¾-in. rock bit and a basket sub above drilled up and recovered the fish while carrying the hole to 6,941 ft.

At this point conventional coring equipment was used, and in three runs obtained 55.4 per cent recovery out of 20 ft. before 7-in. casing was cemented up the hole at 6,912 ft. (total depth 6,961 ft.). A 55.4 per cent recovery with conventional coring procedures was quite typical of the results achieved in this area and was one of the reasons for the attempt to improve recoveries through use of diamond equipment.

The 4½-in. o.d. drill pipe was laid down, a string of 3½-in. o.d. picked up and the cement plug drilled from the 7-in. o.d. casing and 2 ft. of 6¼-in. hole drilled to 6,963 ft. and diamond coring was resumed, obtaining very good results:

Cored		Recovered		Cumulative		
From	To	Feet	Per cent	Cored	Recv.	Per cent
6,963	6,966	2'9"	91.6	3	2.75	91.6
6,966	6,975	8'11"	99.2	12	11.67	97.2
6,975	6,985	2'0"	20.0	22	13.67	62.1
6,985	6,986	5'9"	high	23	19.42	84.5
6,986	6,994	10'3"	high	31	29.67	95.7
6,994	7,003	9'6"	high	40	39.17	97.8

In this part of the operations a pickup of a lost core catcher is illustrated. In core 6,975-85 ft. only 2 ft. were recovered of a 10-ft. run, and the next run—only 1 ft.—was deliberately made short to try for a pickup. This was achieved, getting 5 ft. 9 in. of core in the barrel.

Reamers Acted as Fulcrum

In reviewing performance of this coring operation, trouble with the first three cores deserves special comment. Above the barrel had been used two 4¼-in. o.d. drill collars each 20 ft. long, then an 8¾-in. reamer, then two 6¼-in. o.d. drill collars each 30 ft. long. This equipment had been put on to stiffen the drill stem above the core barrel and prevent the top end of the barrel from wobbling when there was no long rathole. Failure of the diamonds to start cutting, the high torque required to turn the drill pipe, and the excessive surface whip of the kelly, however, lead to the conclusion that the reamer in the middle of the drill collars acted as a fulcrum, and whatever misalignment was present in the four drill collars resulted in gyration in the lower end of the core barrel itself. This action probably whipped the diamond bit head to destruction before it could make sufficient rathole to hold the core bit stationary. The point was pretty well proven in the diamond coring from 6,963 to 7,003 ft. where 97.8 per cent recovery was obtained in coring 40 ft. (above table). In this instance the core barrel was attached directly to the 3½-in. o.d. drill pipe.

Conclusion from Tests

Consensus of those engaged in the four tests was that diamond coring is useful in special situations where the fragmental, vugular, or erratic porosity in limes has to be cored with a light weight scraping action to attain high recoveries, and where for special geological and reservoir study purposes the cost is warranted. The work also proved that diamond coring could be satisfactorily accomplished and high recoveries obtained without the use of hydraulic feeding equipment and with standard rotary tools, provided the equipment was in good mechanical condition and normal working ratings not exceeded.

Coring operation 1 was conducted by the production department of Sohio Petroleum Co., operations 2, 3 and 4 by Gulf Oil Corp. with Gordon C. MacDonald as supervision engineer of the coring work.

The Period of Development

*by Park J. Jones**

THE OPTIMUM RATE OF PRODUCTION

PART 13 OF A SERIES

LET the per-well rate of production be uniform during a period of development. Then the rate of development of a reservoir is equal to the rate of increase of the rate of production. Rates of development vary widely as between reservoirs from a slow initial rate up to comparatively fast initial rates. A slow initial rate of development may be represented by rates of production proportional to cumulative recovery. A rapid initial rate of development may be represented by rates of development inversely proportional to the rate of production. The rates of development found in practice are likely to fall between these two limits. The characteristics of several types of development programs as to rates of production and cumulative recovery are illustrated graphically. A fixed number of rigs and a uniform per-well rig time represents a uniform rate of development, uniformly increasing rates of production. The procedure for estimating the present value of the production accumulated during a period of development is illustrated by an example for uniformly increasing rates of production.

Rate of Development Proportional to Cumulative Recovery

CONSIDER a rate of development proportional to cumulative recovery. The rate of production from a reservoir plotted against cumulative recovery would be a straight line. Let Q be the rate of production to be reached at the end of a development program. Denote the cumulative recovery at the end of the development program by "a." Let p be the rate of production from exploratory wells at the beginning of the development program. The rate of production q during the period of development is then defined by:

$$q = \frac{CQ}{a} + p \qquad (1)$$

Equation 1 states that the rate of production is equal to a constant Q/a times cumulative recovery C plus the producing rate p from exploratory wells. Rates of production p, q and Q are in M.c.f.'s per M.c.f., or barrels per barrel, per year of an initial reserve. Cumulative recovery "a" and C are in M.c.f.'s per M.c.f., or barrels per barrel, of an initial reserve. The cumulative recovery from exploratory wells at the beginning of the development program is neglected.

The rate of production q at any time y during a development program proportional to cumulative recovery is given by:

$$q = pe^{Qy/a} \qquad (2)$$

Equation 2 states that q = p at the beginning of the development program, that is, when y = O. The cumulative recovery at the end of the development program is "a." The cumulative recovery "a" and the rate of production Q desired at the end of the development program determine the rate of development. Equation 2 is derived in the appendix to this article.

The q curves in Fig. 13-1 are solutions of Equation 2. In this example, the conditions are as follows: The cumulative recovery at the end of a development program is 10, 20, or 30 per cent of an initial reserve. The rate of production to be reached at the end of the period of development is 10 per cent per year of the initial reserve. The rate of production from exploratory wells at the beginning of the development program is 1 per cent per year of the 10 per cent per-year rate to be reached. The q curves show the relationship between rate of production and time.

The relationship between cumulative recovery and time is defined by:

$$C = \frac{ap}{Q}(e^{Qy/a} - 1) \qquad (3)$$

The C curves in Fig. 13-1 are solutions of Equation 3. Cumulative recovery in per cent of initial reserve is plotted against time in years. The cumulative recoveries are 10, 20, and 30 per cent respectively at the time the rate of production reaches 10 per cent per year of initial reserve. The periods of develop-

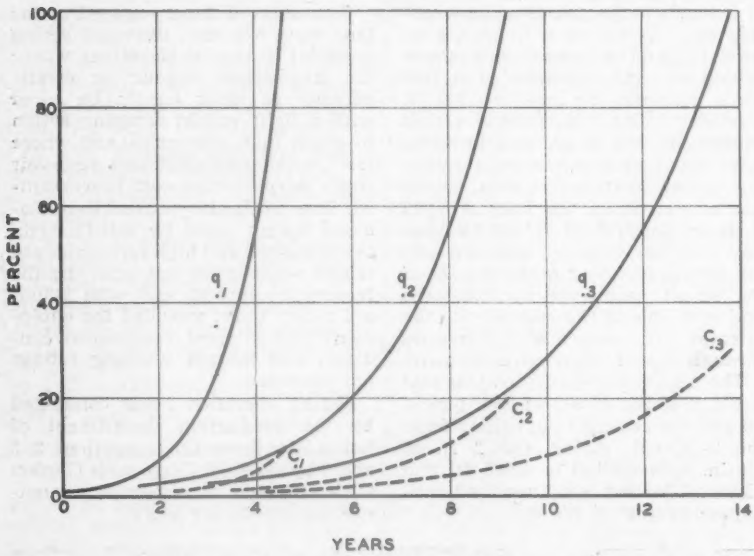


Fig. 13-1—Rate of production and cumulative recovery vs. time for rate of development proportional to cumulative recovery; rate of production q during period of development in per cent of the rate to be reached; rate of production to be reached at the end of a development program is 10 per cent per year of initial reserve; cumulative recovery at end of development program is 10, 20 or 30 per cent of the initial reserve

*Production consultant, Houston.

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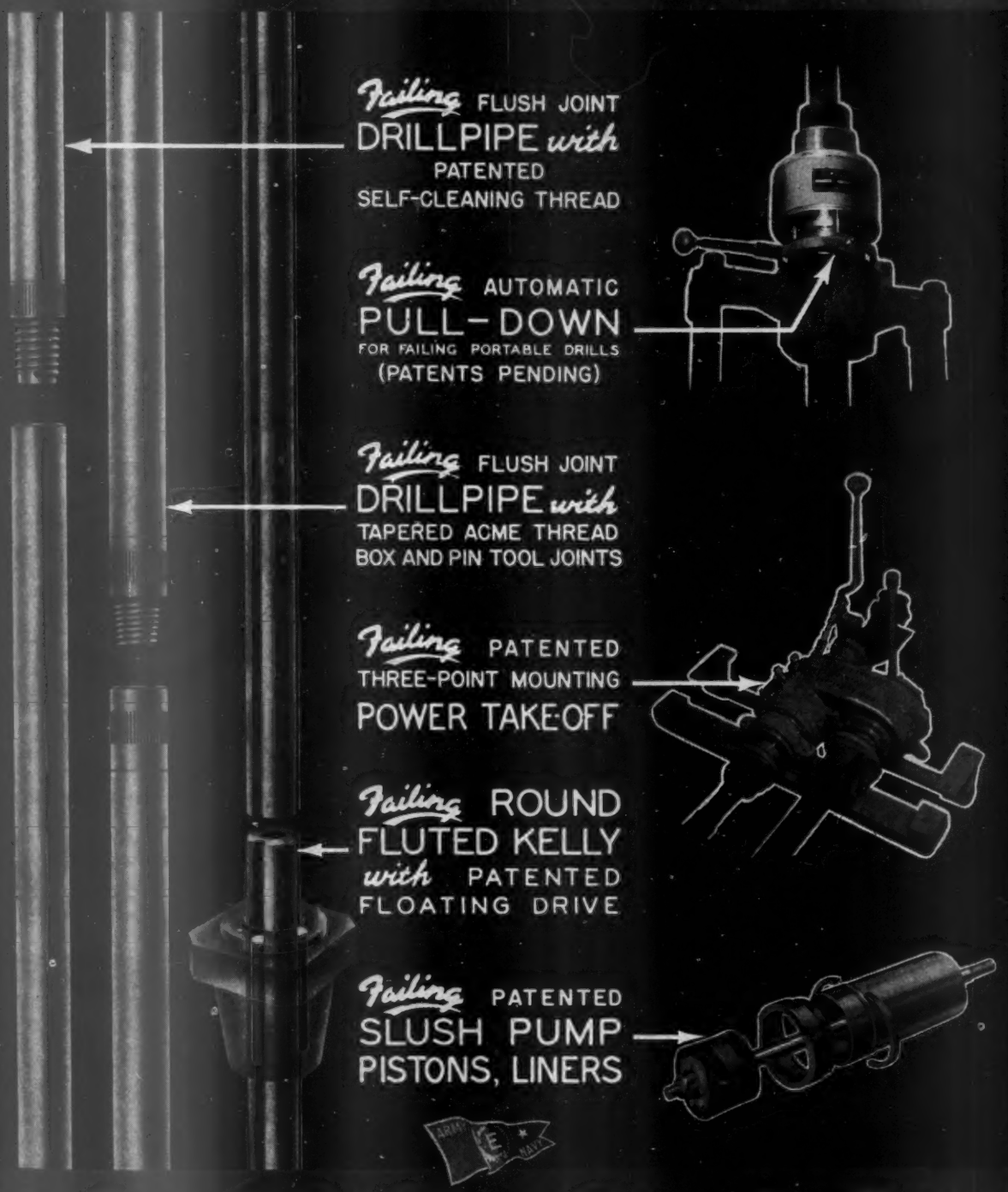

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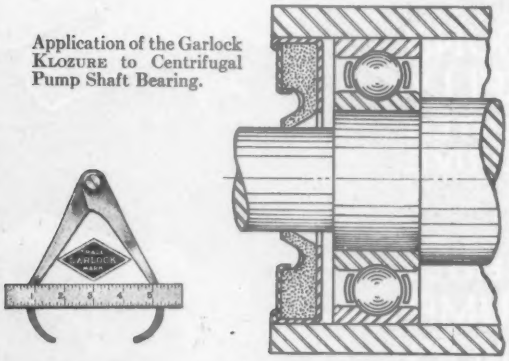

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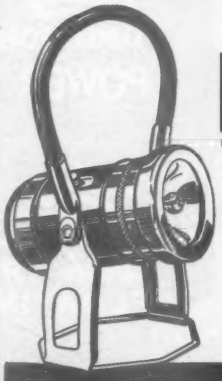

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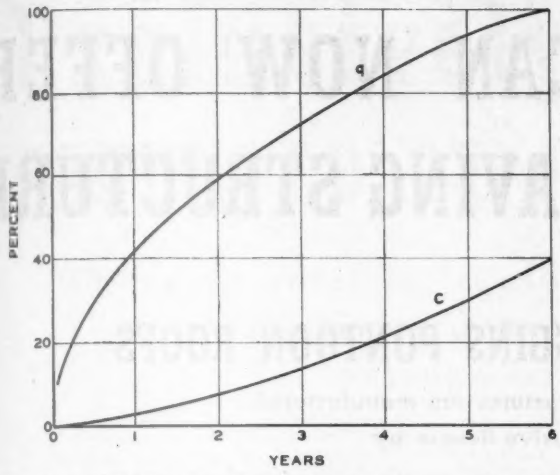


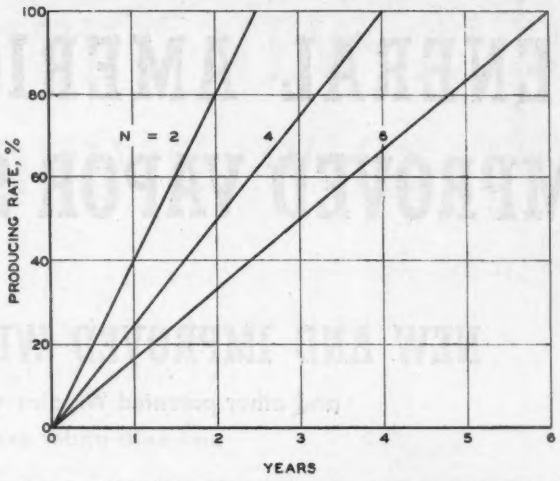


Fig. 13-2—(Left) Rate of production and cumulative recovery vs. time for rate of development inversely proportional to a 10 per cent per year rate of production to be reached at the end of 6 years; cumulative recovery C in per cent of initial reserve; rate of production q in per cent per year of initial reserve times ten. Fig. 13-3—(Right) Producing rate from a reservoir during a period of development; producing rate in per cent of the producing rate to be reached at the end of a development program; N is the duration of a development program

ment range from 4 up to 14 years, depending on the cumulative recovery to be reached. Equation 3 is derived in the appendix to this article.

Rate of Development Inversely Proportional to Producing Rate

Consider a rate of development inversely proportional to producing rate. Let q equal the rate of production at any time y during the period of development. Let Q be the rate of production to be reached at the end of N years. For this condition, the rate of production is defined by:

$$q = Q\left(\frac{y}{N}\right)^{0.5} \qquad (4)$$

The rates of production q and Q are in M.c.f.'s per M.c.f., or barrels per barrel, per year of an initial reserce; y and N are in years. The q curve in Fig. 13-2 is a solution of Equation 4. A 10 per cent per-year rate of production is to be reached at the end of a 6-year development program. The q curve gives the rate of production during the period of development in per cent of the rate to be reached at the end of 6 years.

The cumulative recovery for a development program inversely proportional to producing rate is defined by:

$$C = \frac{2Qy^{1.5}}{3N^{0.5}} \qquad (5)$$

The C curve in Fig. 13-2 is a solution of Equation 5 for a 10 per cent per-year rate of production to be reached at the end of a 6-year development program. Cumulative recovery is in per cent of an initial reserve. We might note that the cumulative recovery is 40 per cent of an initial reserve at the end of six years. Equations 4 and 5 are

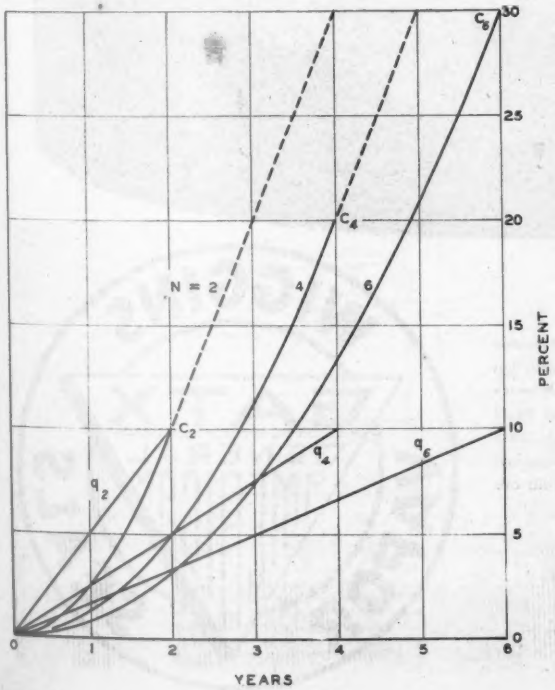
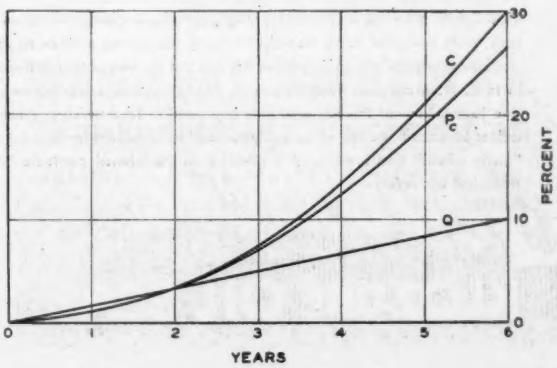


Fig. 13-4—(Left) Producing rate and cumulative recovery vs. time and rate of development; N is number of years required to develop a reservoir; producing rate q in per cent per year of initial reserve; cumulative recovery C in per cent of initial reserve

Fig. 13-5—(Below) Present value P_c of cumulative recovery C vs. time for a uniform rate of development; present value and cumulative recovery in per cent of initial reserve; a 10 per cent per year rate of production is reached at the end of six years; interest rate is 3 per cent



GENERAL AMERICAN NOW OFFERS IMPROVED VAPOR SAVING STRUCTURES

NEW AND IMPROVED WIGGINS PONTOON ROOFS

and other patented Wiggins structures are manufactured and sold under exclusive license by

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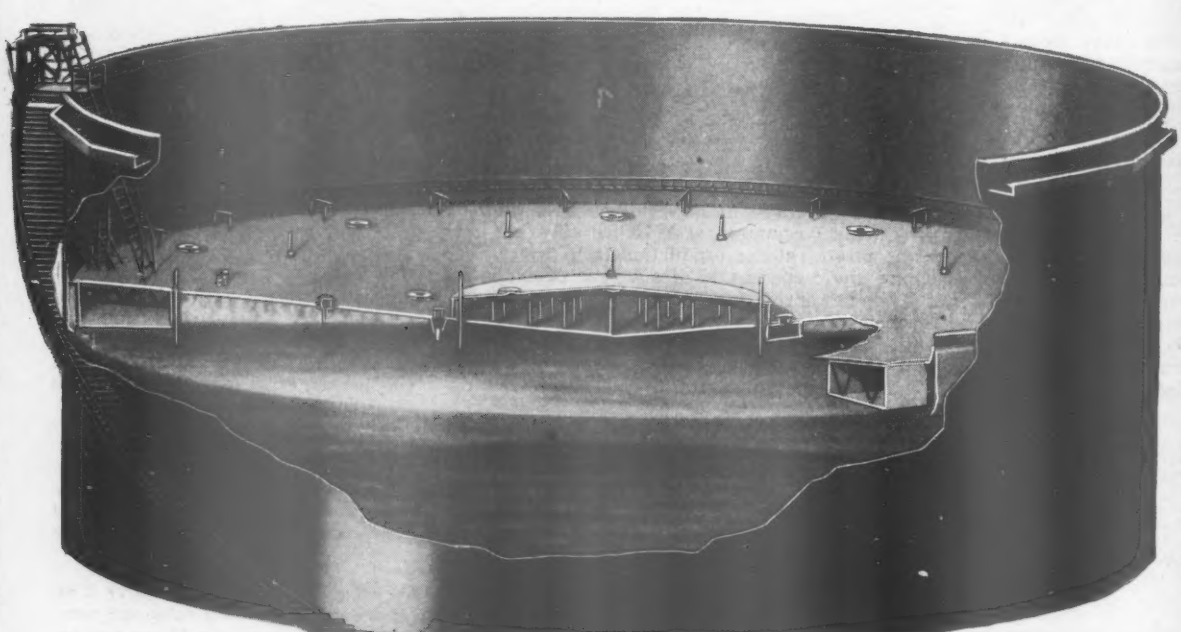


CUT-AWAY VIEW of an improved Wiggins Pontoon Roof installed on butt welded tank. Note how roof floats directly on liquid, blanketing surface at all levels, thus stops evaporation loss and reduces fire hazard by eliminating active vapor space in tank. Note covered center pontoon which prevents evaporation of the liquid due to the heat of the sun, and new improved ladder which provides safe, easy access to deck from top of tank. Upper end of ladder rides around an ingenious "ferris wheel" and lower end is pivoted on peripheral pontoon. Handrails are provided for safety.

WIGGINS VAPOR SEALS
GATX
GENERAL AMERICAN

Exclusively THE NEW AND PATENTED BY JOHN H. WIGGINS

Wherever volatile liquids are stored or processed, Wiggins structures assure important savings, greater safety!

For years General American Transportation Corporation has been out in front in rendering service to the petroleum industry. Now General American has fortified its leadership by acquiring the sole rights to manufacture and sell, as exclusive licensee under John H. Wiggins patents, the new and improved Wiggins vapor-saving structures.

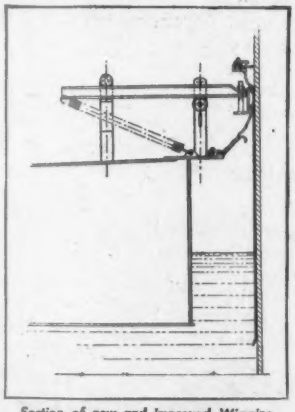
The new Wiggins Pontoon Roof, featuring many improvements, is typical of the many new and improved Wiggins structures manufactured by the General American Plate and Welding division. It can help you solve your evaporation-loss problems, safely and surely, because it floats directly on the surface of the liquid, stops evaporation loss, and reduces fire hazard.

COST AMORTIZED QUICKLY IN SAVINGS

Here are some of the losses which are prevented, eliminated, or reduced by the new and improved Wiggins Pontoon Roof, illustrated at left:

BREATHING LOSSES . . . Whenever increasing temperature causes expansion in vapor space of tanks having a fixed roof, vapor is vented to atmosphere. Losses resulting from this daily exhalation of vapor are called breathing losses—an expensive waste which is stopped by "improved" Wiggins Pontoon Roofs because of their elimination of *active* vapor space.

FILLING LOSSES . . . With fixed roof tanks, vapor is displaced through roof vents during filling. When a tank equipped with an "improved" Wiggins Pontoon Roof is filled, no vapor is displaced because roof floats on the liquid surface. No filling loss occurs from the small space between roof and tank shell because the volume of this space remains constant even when roof is rising.



Section of new and improved Wiggins Pontoon Roof seal showing details of shoes used with butt welded tank shells. A continuous strip of flexible seal material forms wind-proof connection between top of shoe and roof of deck.

BOILING LOSSES . . . In addition to eliminating all filling loss and reducing breathing loss to a minimum, the "improved" Wiggins Pontoon Roof traps vapor, formed by boiling, under the deck. This vapor is retained under roof until recondensed by cooler temperatures.

PROTECTION FROM FIRE

By eliminating the conditions which permit contents of tank to burn, the "improved" Wiggins Pontoon Roof effectively helps prevent fire. Liquid beneath deck cannot become ignited because there is insufficient oxygen present to support combustion. And since the tank has an open top, there is no danger of an explosive mixture forming above roof. The only point where a fire might conceivably burn is in space between rim of roof and tank shell. This space, however, is sealed with a fire-resistant material consisting largely of asbestos woven with glass, and repeated tests have proved that even if seal becomes damaged, a fire in this area can be easily extinguished, even after burning for some time. A complete discussion of the fire retardant features of the unimproved Wiggins Pontoon Roof may be obtained in the "Report on Floating Roof for Vertical Steel Storage Tanks" issued by the Underwriters' Laboratories, Chicago, Ill.

WIDE APPLICATION TO NEW OR EXISTING TANKS

The "improved" Wiggins Pontoon Roof is applicable to either riveted or welded tanks of all 15 ft. diameters or larger. It can be furnished with new tanks or installed in existing tanks, and for this reason finds wide application at pipeline stations, refineries, bulk stations, marine terminals and chemical plants. A sound investment for any large tank storing crude oil or gasoline, the "improved" Wiggins Pontoon Roof is also recommended for service on working tanks, blending tanks and tanks containing corrosive oils.

For complete information regarding the "improved" Wiggins Pontoon Roof or other "improved" Wiggins structures and their possible application to the solution of your special problems, get in touch with our nearest office.

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maintains offices in Chicago, New York, Washington, Cleveland, Buffalo, Pittsburgh, St. Louis, New Orleans, Tulsa, Dallas, Houston, Seattle and Los Angeles

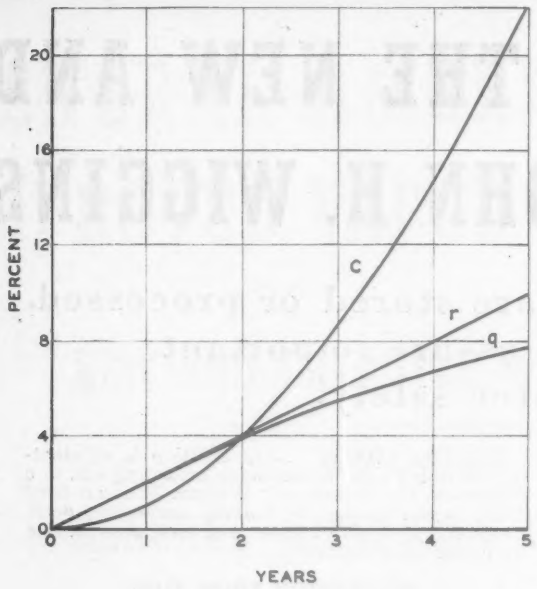


Fig. 13-6—Rate of depletion r, rate of production q and cumulative recovery C vs. time; rate of depletion in per cent per year of reserve; rate of production in per cent per year of initial reserve; cumulative recovery in per cent of initial reserve

derived in the appendix to this article.

Uniform Development Programs

A reservoir may be developed with a fixed number of rigs and a uniform per-well rig time. These conditions represent a uniform rate of development. The rate of production q at any time y during a uniform development program is defined by:

$$q = \frac{Qy}{N} \qquad (6)$$

where Q is the rate of production to be reached at the end of N years. Denote the rate of production to be reached at the end of N years by unity. Then q =y/N and rates of production plotted against time are straight lines as in Fig. 13-3.

The cumulative recovery C at any time y during a uniform development program is defined by:

$$C = \frac{Q}{2N} y^2 \qquad (7)$$

The C curves in Fig. 13-4 are solutions of Equation 7. Cumulative recovery in per cent of initial reserve is plotted against time in years. In this example, the producing rate to be reached at the end of 2, 4, or 6 years is 10 per cent per year of an initial reserve. The solid C curves show cumulative recoveries during development periods. The dashed extensions for the 2 and 4-year development programs are based on the assumption that producing rates are maintained at 10 per cent per year.

Present Value for Uniformly Increasing Producing Rates

A uniform rate of development is accompanied by uniformly increasing rates of production from a reservoir. The present value P_c of the recovery accumulated during y years at a uniformly increasing rate of production is defined by:

$$P_c = \frac{Q}{Ni^2} [1 - (1 + iy)\, e^{-iy}] \qquad (8)$$

where Q is the rate of production to be reached at the end of N years and i is the rate of interest. The P_c curve in Fig. 13-5 is a solution of Equation 8. Present value, in per cent of initial reserve, is plotted against time. The rate of development is uniform and reaches 10 per cent per year at the end of the sixth year. The corresponding cumulative recovery is illustrated by the C curve. Interest rate is 3 per cent. Present value is before investment, taxes, royalty, and operating expenses.

Equation 8 is derived in the appendix to this article. The procedure indicated in the appendix may also be used to estimate the present value of the production accumulated under other than uniform rates of development.

Rate of Development Proportional to Rate of Depletion

Consider rates of development which are proportional to rates of depletion. Let R equal the rate of depletion to be reached at the end of a development period and N, the duration of the program. The rate of production q at any time y during such a period of development is defined by:

$$q = \frac{Ry}{N} e^{-Ry^2/2N} \qquad (9)$$

and the cumulative recovery C, by:

$$C = 1 - e^{-Ry^2/2N} \qquad (10)$$

The curves in Fig. 13-6 are solutions of Equations 9 and 10 for a 10 per cent per-year rate of depletion to be reached at the end of 5 years. Cumulative recovery is in per cent of initial reserve. The rate of production is in per cent per year of initial reserve. Rate of depletion, r = Ry/N, is in per cent per year of reserve. The rate of depletion increases 2 per cent per year and reaches 10 per cent per year at the end of 5 years. Equations 9 and 10 are derived in the appendix to this article.

Appendix to Article 13

In order to derive Equations 2 and 3, we note that:

$$\frac{dC}{dy} = q = \frac{CQ + ap}{a}$$

so

$$\int \frac{QdC}{CQ + ap} = \frac{Q}{a} y$$

from which

$$\log \frac{CQ + ap}{ap} = \frac{Q}{a} y$$

and

$$C = \frac{ap}{Q} (e^{Qy/a} - 1)$$

but

$$C = \frac{a}{Q} (q - p)$$

so

$$q = pe^{Qy/a}$$

In order to derive Equations 4 and 5, we note that:

$$\frac{dq}{dy} = K/q$$

from which

$$\frac{q^2}{2} = Ky \text{ or } K = \frac{q^2}{2y}$$

Substitution of Q and N for q and y gives:

$$K = \frac{Q^2}{2N} \text{ and } q = Q \left(\frac{y}{N}\right)^{0.5}$$

but

$$\frac{dC}{dy} = q = (2Ky)^{0.5}$$

so

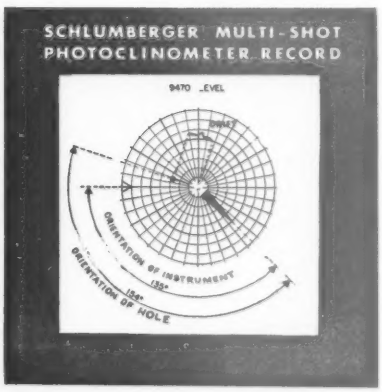
$$C = \frac{2(2K)^{0.5}}{3} y^{1.5}$$

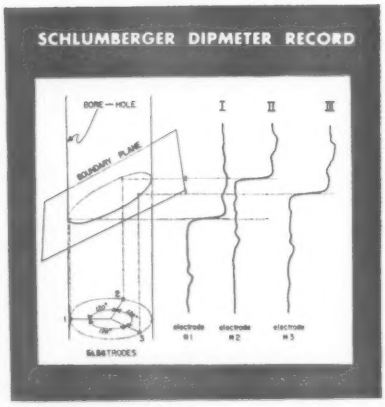
(Continued on page 143)

SCHLUMBERGER DIPMETER

PROVIDES QUICK, ACCURATE DETERMINATION OF DIRECTION AND VALUE OF FORMATION DIP

With the same high degree of accuracy that has distinguished Schlumberger Electrical Well Logging, you may now determine formation dip and direction values. The Dipmeter combines two proven Schlumberger services — electrical well logging and photoclinometer directional surveys. The instruments are lowered into the hole on a standard Schlumberger cable, requiring only one trip in the well for the entire Dipmeter Survey. Simultaneous recordings are made of the drift and orientation of the well bore, the orientation of the instruments, and of three self-potential curves of the formation being investigated. Upon obtaining these data, the direction and magnitude of the formation dip can be determined easily with the aid of computing apparatus developed by Schlumberger.





The following figures briefly outline the operations involved in a Dipmeter Survey:

Schlumberger Multi-shot Photoclinometer Record

This record, which is obtained at the same time the Dipmeter is lowered into the hole, registers the drift angle of the hole, direction of drift, and orientation of the dipmeter instrument.

Schlumberger Dipmeter Record

The Dipmeter is an adaptation of Schlumberger electrical logging. A self-potential curve is recorded on each of three electrodes spaced 120° apart in a plane perpendicular to the axis of the hole. The shift in depth, as revealed by the three curves, may be translated into dip value.

Schlumberger Dip Computing Instrument

The Dip Computing Instrument is a mechanical device whereby formation dip and direction may be quickly determined by using data from the Dipmeter and Photoclinometer without lengthy mathematical calculations.

SCHLUMBERGER WELL SURVEYING CORP.

HOUSTON, TEXAS

QUESTIONS on TECHNOLOGY

by W. L. Nelson
Consulting Engineer

Sodium Exhaust Valve For Aircraft

We have heard of an exhaust valve used in aircraft engines which was made or faced with the metal sodium. Can you tell us of this? It seems that sodium would burn.—R.G.R.

The metal sodium does oxidize or burn readily and of course would not be suitable for the main body or surface of an exhaust valve.

What is probably referred to in the question is a hollow-type valve

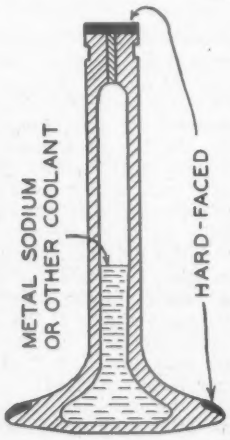


Fig. 1

which contains an internal coolant. One of the cooling agents that has been used is metallic sodium. Although the extra cooling afforded by a confined cooling agent is not great, it apparently is enough of an advantage to justify its use because such valves have been widely used in aircraft construction. Fig. 1 indicates the construction of one such valve. Note the use of Stellite as a hard-facing material and metallic sodium or some other high-conductivity liquid (low melting) as a heat-transfer agent.

White Lead Test For Naphthas

What is the white lead test for solvents?—J.H.B.

Thinners, naphthas, etc., used in the manufacture of paints may cause a discoloration of white-lead pigment if the naphtha contains sulfur compounds. A direct method of checking the tendency of the naphtha to cause discoloration is the so-called white lead test. It is conducted by mixing about 25 gr. of dry white lead with 50 cc. of the naphtha in an evaporating dish. The dish is heated for 2 hours on a steam bath, using a watch glass cover, and is then set aside for 18 hours. A satisfactory naphtha causes no appreciable darkening. Care must be taken to see that sulfur fumes from gas burners, etc., in the laboratory do not cause discoloration.

Solvents From Catalytic Cracking

We understand that 300°-400° F. naphtha made by catalytic cracking is suitable for making solvents. For what purposes are such solvents used and how good are the solvents made by catalytic cracking?—L.C.F.

There are two general types of solvents or naphthas:

1. Petroleum naphthas consisting of straight-run products of crude oil.
2. High-solvency naphthas consisting largely of aromatic hydrocarbons such as those found in coal tar but which may be made from or extracted from the products of some petroleum processes.

Naphthas made from regular catalytically cracked stocks would be superior to the petroleum naphthas of group (1) but would fall short of the high solvency required by group (2). Special high-temperature cracking is required to make real high-solvency naphthas. The hydroforming process is said to produce large amounts of aromatics and if the catalytic cracking processes were operated at a higher temperature they would probably produce stocks that make superior naphthas but would need to be further treated by solvent extracting or other means to make solvents of the type of group (2).

Except for stocks that may be rich in olefin hydrocarbons, the aniline point is directly related to the content of aromatic hydrocarbons and the power to act as a solvent. The following tabulation shows the relation of characterization factor, gravity and aniline point for 300°-400° F. materials.

	A.P.I. gravity	Characterization factor	Aniline point
Pure paraffin hydrocarbons	58	12.5	176° F.
Paraffin-base	55	12.3	163
Mixed base	48	11.8	136
Thermally cracked	43	11.5	122
Naphthene base	41	11.4	117
Aromatic base* crude oil	38	...	109
Catalytic naphtha	35.9	11.1	63
Coal-tar products	30	10.0	under 40

*Only a few such crude oils are aromatic base; the percentage of aromatics in them is not very high. See Refiner's Notebook No. 15, The Oil and Gas Journal, page 101, October 28, 1944.

Thus gravity is some indication of the solvency power of a naphtha. In addition to aniline point, such tests as the Kauri-butanol number and the nitrocellulose dilution ratio tests with butyl acetate and with ethyl acetate (see Questions on Technology, The Oil and Gas Journal, page 117, June 30, 1945) are frequently used to determine solvency power.

Naphthas in the general range of 300°-400° F. are used for many purposes. Among these are:

Petroleum naphthas:

1. Dry cleaning
2. Metal washing or degreasing
3. Machinery washing
4. Paint thinner for flat finishes
5. Diluent in antirust compounds
6. Leather and bone degreasing
7. Textile printing and proofing
8. Diluent for floor coverings
9. Wax and polish diluent
10. Wash for printing plates or rolls.

and in addition the high-solvency naphthas can serve the following purposes as well as most of the services listed for petroleum naphthas.

High-solvency naphthas:

1-10. Same as petroleum naphthas.
11. Rubber cement solvent
12. Rubber tire manufacture.
13. Lacquer or resin diluent
14. Rotogravure ink
15. Adhesive tape solvent
16. Paint removers
17. Turpentine substitute
18. Zylol substitute
19. Wood-preservative solvent.

Other uses for solvents are discussed on page 134 of the April 15, 1943, issue of The Oil and Gas Journal.

It would be expected that catalytic cracked naphthas would, in time, replace the petroleum naphthas for most services. Their solvency is somewhat superior to that of the petroleum naphthas and this permits the use of higher-boiling, safer naphthas. Unless the catalytic naphthas were purified by extraction or other processes, it is not expected that they can directly compete with the high-solvency naphthas.

Technical Oil Mission Studies German Petroleum Research Activities

*by W. J. Schroeder**

The author was one of a group of petroleum technologists who last April made a tour of Ruhr Valley refining plants. Both American and British technologists comprised the mission, purpose of which was to study new developments by German industrialists in the operation of Fischer-Tropsch and hydrogenation plants, and the interlinking of these plants with the German chemical-manufacturing industry. Among the interesting bits of information gleaned by the investigators was that the Germans had set up four underground lubricating-oil plants as part of their wartime petroleum operations, one of which was nearly completed at the end of the war. This article is a slightly abridged version of a report presented at the A.P.I. meeting in Chicago last week.

DURING the summer of 1944, as it became more clearly apparent that the German war machine was finally faltering, the petroleum industry and the Government of the United States pushed forward the rapid development of plans for investigating the German synthetic-fuel industry. A group of experts, which finally totaled 23, was selected to cover every phase of the petroleum and synthetic fuel plant and research activities. The qualifications for these individuals were an expert knowledge of one or more phases of oil work, a reasonable and in most cases a good speaking and reading knowledge of German, and the stamina necessary to endure the hardships of investigations under war conditions. . . .

About the middle of February, as the Allied Armies approached the Rhine, six members of the group were dispatched to London. Since this was a combined investigation to be carried out with the British, the necessary coordination was developed by this preliminary group. In the first few days of March a Fischer-Tropsch plant at Moers, and a hydrogenation plant at Wesseling were captured and opened for investigation. An I. G. Farbenindustrie plant at Ludwigshafen was captured on March 23 and the following day 65 technical experts, the largest team assembled for a single target and including experts interested in many items other than oil, swarmed over the huge chemical plant which covered an area of many square miles. Seizure of these plants was followed rapidly by the opening of the Ruhr and finally by the withdrawal of the Germans from Leipzig, Leuna, Zeitz, Bohlen, and Lutzkendorf. Many plants in the Hamburg area, particularly crude-oil refineries, were also examined. Leuna was the most important oil target in Germany and it was reported that the concentration of antiaircraft guns at Leuna was greater than around Berlin. . . .

In most of the plants the buildings were destroyed, equipment was blown out of place, supporting structures were badly damaged with parts completely gone. . . . Pipe lines and other connections between various units of the plants seemed particularly susceptible to damage by concussion and were down in all areas of the plants. In some cases the bombing was so thorough that it seemed as if there were hardly a radius of 100 ft. in which a bomb had not been dropped. . . .

In addition to the problems caused by bombing, there were those of operation arising from overall deterioration of the German economy. Indicative of the conditions is the detailed story of securing satisfactory catalysts for a polymerization plant. The plant was built in 1939 by an American organization, but owing to the difficulties of transport when war broke out no catalyst arrived. Finally an attempt was made to obtain catalyst via Japan, and the order was placed and executed. The catalyst got as far as Russia, when the war between Russia and Germany broke out, so that naturally it never arrived in Germany. A correspondence began with the Ruhrchemie regarding the provision of catalyst, and Ruhrchemie provided a phosphoric acid catalyst which it claimed had proven suitable as a polymerization catalyst in other plants. Within 24 hours of using this catalyst it was caked into a solid block, and considerable difficulty was experienced in digging it out. Ruhrchemie, however, insisted that this was a suitable catalyst and further experiments were carried out on the Ruhrchemie pilot plant, where they claimed to get success. A pilot plant was then built at the polymerization plant, and this was blocked up with the Ruhrchemie catalyst. However, by perseverance the workers discovered that one of the reasons for their troubles was air getting in with the field gas from Nienhagen, and they took steps to exclude air from the gas to the main polymerization plant, having already had a run of at least 240 hours on the pilot plant. Unfortunately for them, however, at this stage the bombing began to be much more of a nuisance, and every time they were ready to start the polymerization plant it was bombed. Finally the bombing became so intense and the polymerization problem the least of their difficulties, that the repairs to the polymerization plant were placed at the bottom of the list after each bombing, with the result that what is left of it has still never been operated.

To meet the bombing threats, the Germans attempted to develop an oil industry underground. Units were to be of comparatively small size and were dispersed through the country. Evidently a very large number would have been needed to meet requirements and the job would have taken a long time even under normal conditions. Slave labor was often used for the heavy underground work without mercy or consideration for the number of lives required in the construction operations. . . .

Control of German Oil Industry

The German oil industry was completely controlled from Berlin. Operations were directed from a central bureau and all plants closely coordinated. Very little finished product blending was carried out at the point of manufacture. Normally, the blending stocks, carefully disguised under code names, were shipped to WIFO (Wirtschaft Forschung), underground, camouflaged blending plants. A number of these plants throughout Germany were examined and many were of tremendous size. At Hitzacker and

*Chief, Office of Synthetic Liquid Fuels, Bureau of Mines, Washington, D. C. Published by permission of the Director, Bureau of Mines.

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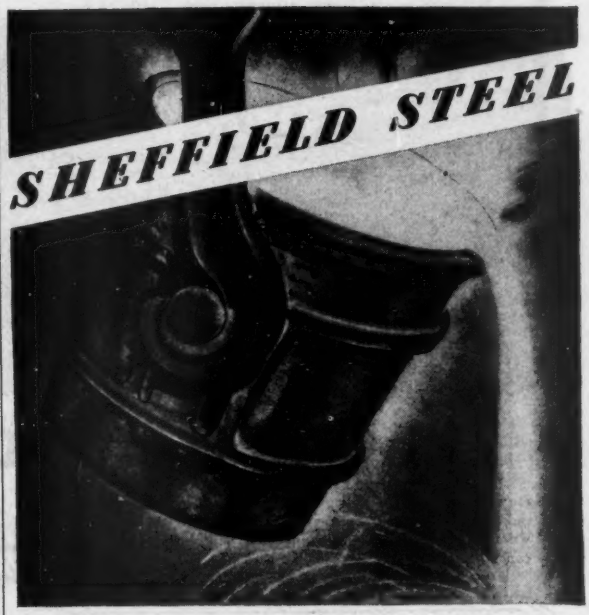

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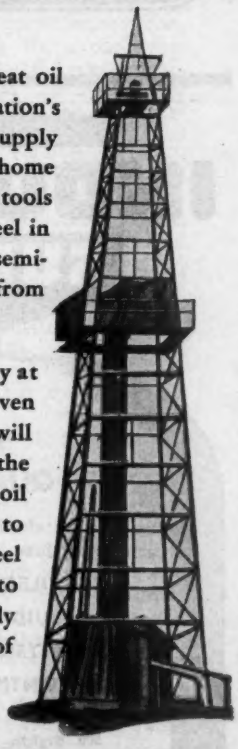

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Akin the plants were in pine forests, and everything was underground including tanks, pump stations, and all delivery equipment. Blending formulas, amount of tetraethyl lead to be used in aviation gasoline or additives for lubricating oil were all specified by the control office in Berlin. In this way, the make-up of the finished products was known only to a limited number in the Nazi innercircle.

Fischer-Tropsch Operations

The first Fischer-Tropsch plant investigated was at Moers, a small town east of Krefeld, on the west bank of the Rhine. All other Fischer-Tropsch plants were in the Ruhr (exclusive of those which may exist in the areas seized by the Russians) with the exception of a commercial plant at Lutzkendorf and one small pilot plant near Leipzig. Information on plant operations was not difficult to secure. It was found, however, that documents from the large Ruhrchemie organization at Sterkrade-Holten, from the Moers plant, and from the Kaiser Wilhelm Institute at Muhlheim Ruhr, all of which carried out laboratory research, had been evacuated. The location of this material was not discovered unitl investigators had succeeded in tracking down and interrogating Martin, the president of Ruhrchemie and Hagerman, one of his assistants. These men revealed that most of the Fischer-Tropsch research material had been shipped into central Germany, some being hidden in the mines and barracks belonging to the Herman Goering Works and the remainder taken to a castle at Reelkirchen near Blomberg, Germany. This material was eventually located by the investigators and all important documents evacuated to London.

All Fischer-Tropsch plants in Germany operated by essentially the same process, with only minor variations. In fact, no Fischer-Tropsch plant has been built since 1938, a decision which hinged apparently on the German conviction that they would be able to seize other sources of oil, such as those in Russia, and did not need to expend additional funds, manpower, and material for synthetic oil plants.

Synthesis gas for the plants was made almost universally by the water-gas reaction, using coke. Experimental work using brown coal as raw material was being tried in the Leipzig area. Purification of the gases was carried out in two steps using iron oxide catalysts to remove H_2S and iron oxide catalysts treated with sodium carbonate to remove organic sulfur. In the latter case a small amount of oxygen was bled into the gas before purification was attempted. The ratio of hydrogen to carbon monoxide was balanced by the use of a shift converter to react CO and water to produce hydrogen or by means of cracking coke oven gas thermally or catalytically. Where coke oven gas was used, an active carbon absorption system was frequently necessary to remove resinous material. This step generally preceded passage of the gas to the organic sulfur removal equipment.

The Fischer - Tropsch converters consisted of atmospheric - pressure type or a medium-pressure type used at about 10 atmospheres. The latter seemed to be preferable. All commercial operations were carried out with the cobalt, thoria, magnesia, and kieselguhr catalyst. The preparation and running-in of the catalysts is extremely important and complete details of all operations have been obtained. There was no commercial production of Fischer-Tropsch material with iron catalyst although pilot plants were being operated. The Ruhrchemie group did not seem to be particularly impressed with the iron catalyst since losses with cobalt catalysts had been reduced to a low level, long life had been secured, and furthermore the effect of the catalyst costs on the ultimate production costs was relatively slight.

In general, the plants operated on two stages with about two-thirds of the converters in the first stage and one-third in the second. One plant used a three-stage process. Recycling the gas through the converters had been tried only in pilot-plant operations. There were two schemes for doing this. In the first, the gas was recycled through the converters about three volumes to each one withdrawn, using a cobalt catalyst with internal heat exchange. In the second, an iron catalyst was used with a recycle rate of about 100 to 1 and the gas was cooled externally to carry the heat of reaction away. Both the recycle operation and the use of the iron catalyst increased the octane rating of the product as a result of increased olefin content. The recycle operation also afforded a practical means of controlling the boiling range.

The yield and quality of the products were about as anticipated from published information. Light gasoline of a low octane number was secured which was blended for motor fuel. The diesel oil fractions had cetene numbers from 80 to 100. The paraffin wax, or "gatsch" as it is called by the Germans, was particularly desired for use in soap manufacture. It was also used for the synthesis of lubricating oil. Olefins in the overhead fractions were frequently converted to alcohols.

The research at the Kaiser Wilhelm Institute has developed a fairly comprehensive picture and overall understanding of the reaction involved in the synthesis of liquid and gaseous products from CO and hydrogen. At relatively low temperatures and pressures the products are largely straight-chain paraffins. In the temperature range of from 300° to 400° C. under moderate pressure, there is a considerable production of alcohols; from 400° to 475° C. at elevated pressure of 200-300 atmospheres isoparaffins are obtained; and above this in the range up to 500° C. there is some production of aromatics. The composition of the catalyst also has an important effect on the reactions.

Synthesis of Alcohols, Isoparaffins and Aromatics

Several methods have been developed in Germany for the production of alcohols in connection with the Fischer - Tropsch process. The plant at Moers absorbed olefins in sulfuric acid and after separation hydrolized the product for the direct production of alcohol. This was used particularly for the preparation of propyl and butyl alcohols. A more interesting method, called the OXO process, was under development by Ruhrchemie; in fact, a plant had been built at Sterkrade-Holten which was about ready to go into operation. This was intended for the production of higher alcohols for use in detergent manufacture, particularly those in the group from C_{12} to C_{18}. The general type of reaction depends upon the addition of CO and hydrogen to an olefin to form an aldehyde which was then hydrogenated for conversion to alcohol. The process is carried out with a cut of Fischer-Tropsch primary product in the C_{11} to C_{17} range containing about 40 per cent olefins. This is reacted with carefully purified gas containing about 10 per cent more hydrogen than CO over a Fischer-Tropsch cobalt-thorium catalyst. The aldehyde is distilled off and hydrogenated over a nickel catalyst for conversion to alcohol. It is stated that this process can be used for the production of alcohol from C_2 to C_{20}, although it is largely applied in range from C_{12} to C_{18}.

Another process for the production of alcohol which was described as in laboratory state involved a direct synthesis from water and olefins. At a pressure up to 200 atmospheres and temperatures below 300° C. it was reported that ethylene and propylene and probably other unsaturates could be converted to alcohols by reaction with water in the presence of tungsten oxide supported on silicate gel.

The synthesis of isoparaffins has been accomplished only on a laboratory scale but is of primary interest in offering means for producing fuel of a good octane rating by the Fischer-Tropsch process. The reaction can be carried out with catalysts of Al_2O_3, ThO_2, or ZnO, and

various mixtures of these three materials. At pressures near 300 atmospheres and a temperature of about 400° C., the yield per unit of catalyst is relatively high. The synthesis gas contains about 20 per cent more CO than hydrogen. The yield of C_4 and C_5 material plus a small amount of C_6 runs in the neighborhood of about 100 grams per cubic meter of synthesis gas. The C_4 and C_5 fractions generally contain above 90 per cent of isocompounds. Some alcohols are also produced.

Extensive experimentation has been carried out in the laboratories for the synthesis of aromatics in the range from 475° to 500° C. at elevated pressures. A variety of catalysts consisting of chromium, molybdenum, and thorium oxides have been tried. The yield of liquid products was very low but it did contain about 50 per cent aromatics, the remainder being largely naphthenes. This research was not considered promising in Germany.

Hydrogenation Process

The principal information on the hydrogenation process was obtained from the plants at Ludwigshafen-Oppau and Wesseling on the west bank of the Rhine and from the plants in the Ruhr and at Leuna east of the Rhine. The Oppau plant was small, producing only about 20,000 metric tons per annum and was primarily intended for pilot plant operations. The processes used in the "sumpf" or liquid phase operations were not materially different from these known in this country and in England and generally were as follows:

Coal and coal tar was hydrogenated in the sumpf phase, usually employing an iron catalyst at 700 atmosphers. The product was rerun to yield gases through C_4; light gasoline to 100° C.; hydro-naphtha to 220° C.; middle oil from 220°-360° C., and slag. The gas was super fractionated to secure methane, ethane, propane, isobutane, and normal butane. The C_1 through C_3 fraction was often used to manufacture hydrogen. The isobutane was dehydrogenated to isobutylene which was polymerized to diisobutylene and subsequently hydrogenated to isooctane and shipped to blending plants for aviation gasoline manufacture. The light gasoline fraction having an 86-87 A.S.T.M. octane number (with 4.5 cc. of tetraethyl lead per U.S. gallon) was a second component of aviation gasoline. The hydro-naphtha passes to the dehydrogenation plant (DHD) where the naphthenes are converted to aromatics using a chromium catalyst. The DHD product, containing from 50 to 75 per cent aromatics and testing 85-90 octane number (with lead) is another aviation-gasoline blending stock. The middle oil from the sumpf phase is hydrogenated in the gas phase, using tungsten sulfide catalyst, and the hydrogenated product is rerun as already stated. According to Dr. Pier, this type of operation was used at Ludwigshafen-Oppau and other German technologists stated that this system was followed at Leuna, and Politz as well as some other plants.

The high pressure in the sumpf phase was necessary with an iron oxide catalyst because it has a relatively low activity compared with tin oxide. Increased temperature and pressure compensated for the lower catalyst activity. The major production from the hydrogenation plants went to aviation gasoline and about 80 per cent of this material was reported to be from synthetic sources.

In the hydrogenation plant at Bottrop Welheim in the Ruhr, aviation gasoline was made in one step from sumpf phase middle oil from bituminous coal tar. This involved hydrogenation carried out at 700 atmospheres over a catalyst containing molybdenum, chromium, zinc, and sulfur. Two stills were used in series. The product contained 60 per cent aromatic material and could be leaded to about 92 octane. It had excellent rich mixture performance. This process was claimed to have material advantage over other processes used for the manufacture of high octane gasoline.

Processes for the Production of Lubricating Oil

The problem of producing suitable types of lubricants for all purposes was of serious concern to the Germans throughout the war. Lubricating oil from petroleum was not sufficient to meet the demand and did not have the characteristics required for all applications. This situation forced the Germans into an extensive study of lubricating oils and means for producing them. This work met with a high degree of success and at the end of the war they were able to supply all of the necessary types of lubricants although not always in sufficient quantity. Four methods were in commercial use. One of the simplest which was well known before the war involved the cracking of Fischer-Tropsch wax or oil and subsequent polymerization to yield lubricating oil. The product was quite satisfactory for use as a general-purpose lubricant and for automobile motors. It was also reported that at the Nordeutche Mineral Oel Worke at Politz that aviation lubricating oil with 110-120 viscosity index was made by special modifications of this process.

Another process which started with Fischer-Tropsch middle oil involved chlorination of this material and subsequent reaction of the chlorinated product with naphthalene in the presence of an aluminum chloride catalyst to yield a lubricating oil. This was neutralized, purified, and separated into greases, spindle oil, turbine oil, and motor lubricants. It did not yield exceptional high-grade material.

A very high-grade synthetic lubricating oil was obtained by synthesis from ethylene. Much of the ethylene used for this purpose was obtained from acetylene. At Huls acetylene was made from a methane-ethane mixture by an electric arc process. Ethylene was also manufactured by cracking ethane with oxygen under carefully controlled conditions. The gases resulting from the cracking process were purified by washing with caustic to remove organic acids and formaldehyde, by hydrogenating to remove acetylene and oxygen, washing with oil to remove paraffin and other hydrocarbons and finally stripping with active charcoal. The resulting purified ethylene was polymerized batch-wise in the presence of specially prepared aluminum chloride catalyst. The product was refined and separated into various grades of lubricants. By this process oil could be obtained with a viscosity index as high as 115 and with good characteristics so far as could be determined by ring-sticking tests. It was used in admixture with lubricants from petroleum for airplane engines. Some of the most important lubricating oil plants were at Leuna, Schkopau, Sterkrade-Holten, Politz, and Hamburg.

At Leverkusin a method was under development for the production of synthetic lubricating oil by copolymerization of tetrahydrofuran and ethylene oxide in the presence of $FeCl_3$ and $SOCl_2$. The process had not reached commercial utilization.

The material and processes reported in this paper have only attempted to cover the highlights of the information secured from the investigation of the German synthetic-fuel industry. Detailed data are not given, for they will be reported by the individual team members in subsequent reports on each process or plant where investigations were conducted. When this work is completed, it is believed that the United States will have not only a comprehensive but detailed picture of the German liquid fuel industry.

Acknowledgments

The writer has attempted to present briefly some of the experiences of the 23 investigators who went to Germany. He is indebted to all of them for their oral and written descriptions of their expeditions. Special acknowledgment is due to P. K. Kuhne, H. V. Atwell, A. R. Powell, L. L. Hirst, and H. H. Storch for their assistance.

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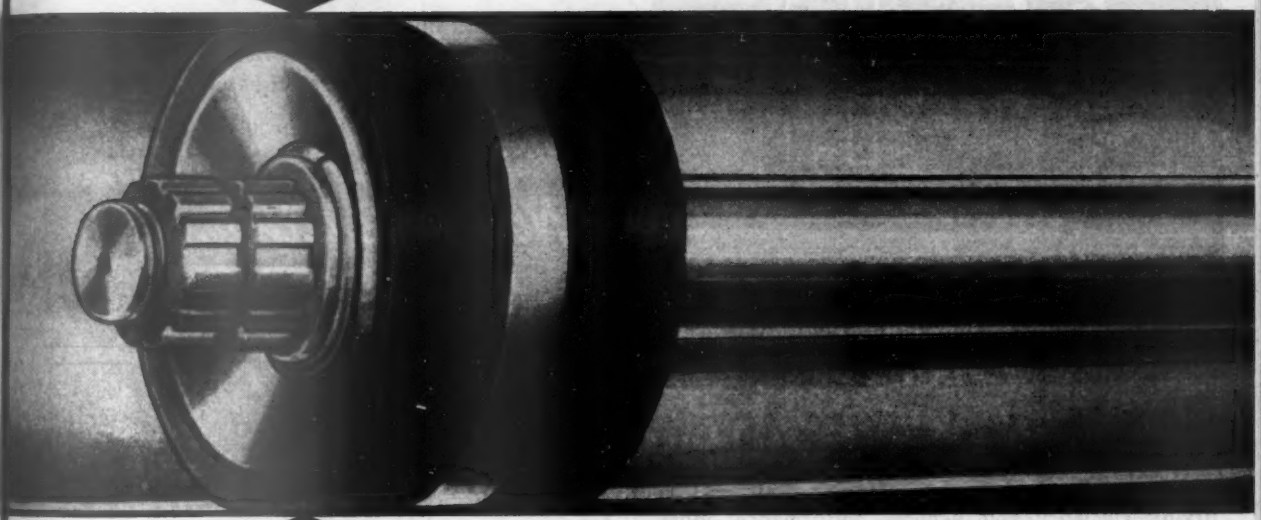

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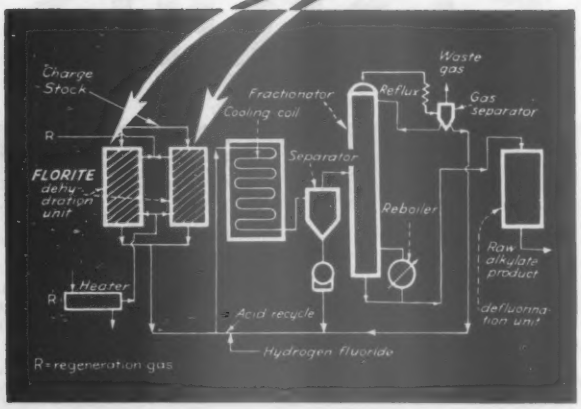

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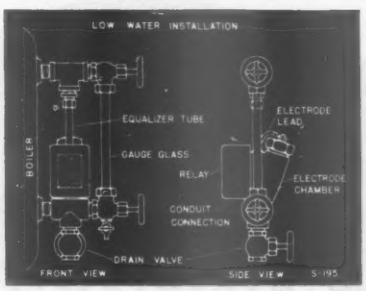

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Liquid-Charge Technique In T.C.C. Processing

by T. R. Simpson, S. C. Eastwood* and H. G. Shimp†*

A.P.I.

ABSTRACT

An adaptation of the T.C.C. process, called "liquid-charge technique," is described for catalytic cracking of the heaviest types of petroleum charge stocks. Catalyst-to-oil ratios need not be high to achieve the desired conversion with reasonable oil and catalyst inlet temperatures. Studies on a number of stocks show that catalyst-to-oil ratios of 1.8 to 4.0, by volume, are adequate. Overcracking may occur at higher catalyst-to-oil ratios, resulting in a rapid increase in coke and gas production with a loss in gasoline yield and liquid recovery.

Charge stocks should be below about 4 per cent by weight Conradson carbon residue to maintain coke laydown at reasonable levels. Heavy asphaltic stocks give excessive coke, and should be deasphalted before they are charged to the cracking unit. Deasphalting greatly reduces coke laydown, and results in improved yields of motor gasoline from a given capacity unit.

Data are given to demonstrate that the liquid-charge technique catalytic reaction proceeds extremely rapidly, with about 70 per cent of the cracking occurring at a point representing only 12 per cent of the total path through the reaction zone.

Introduction

AS a means of conserving petroleum reserves and establishing well-balanced refinery operations, it is highly important to convert petroleum stocks into maximum yields of gasoline and light fuels and to minimize the production of heavy fuels. Over a period of years such processes as thermal viscosity breaking and coking have been developed for converting heavy fuel oils into gasoline and lighter fuels, but these methods have found only limited application due either to economic factors or limitations related to the quality of the products obtained. Catalytic-cracking processes, which have been installed on an enormous scale during the war, will serve to improve the gasoline to heavy fuel-oil balance to a marked degree, because they produce high yields of high-quality gasoline with light fuel oil as a byproduct, rather than heavy fuel such as is produced in conventional thermal cracking operations. However, even catalytic cracking has been somewhat limited in application because of process limitations with respect to handling oils of high boiling point—with the result that, prior to the war and during the war, catalytic charge stocks had end points below about 1,000° to 1,050° F., and dew points below about 850° F. The latter limitation was made to facilitate maximum production of war products such as aviation gasoline from a minimum equipment installation.

The Thermofor catalytic-cracking (T.C.C.) process[1,2,3,4] was one of the major contributions to the war program, and during the war period most of the T.C.C. projects were operated on the type of charge stocks described previously herein. Nevertheless, several months ago an adaptation of the T.C.C. process[5] was introduced for catalytic cracking of the heaviest types of petroleum charge stocks without restriction to boiling range, and converting them into high yields of high-quality motor gasoline and distillate fuel oils. The latter application of the T.C.C. principle is referred to as "T.C.C. liquid-charge technique," and the purpose of this paper is to describe it in more detail than in the original publication.

The original T.C.C. process and the liquid-charge technique are both developments of the Research and Development Laboratories of Socony-Vacuum Oil Co., Inc., at Paulsboro, N. J. Their further development and engineering are being conducted by the latter concern in cooperation with Houdry Process Corp. The T.C.C. process, including the liquid-charge technique, is made available to the industry through licenses granted by Houdry Process Corp.

The principles and operating features of T.C.C. have been thoroughly described in previous publications, and do not require detailed description here; but it will be of interest to review some of the salient features, particularly in the light of their bearing on the liquid-charge technique. The catalyst flow system for liquid-charge technique is essentially the same as for vapor-phase operation, although the rate of catalyst circulation may in some cases be higher. Thus charge stock containing as much as 50 per cent liquid when injected into the reaction chamber can be processed satisfactorily when the equivalent of 100 to 150 tons of catalyst per hour per 10,000 bbl. per day of oil charge are circulated. On the other hand, when very heavy charge stocks are processed, which may be almost 100 per cent liquid when injected into the reactor, it has been found desirable to increase the catalyst circulation rate to as much as twice that for vapor-phase operation in order to maintain the catalytic system at an efficient operating level. It should be realized, however, that even when processing very heavy charge stocks, the catalyst-to-oil ratios utilized are remarkably low.

The determination of optimum catalyst circulation rate with liquid-charge technique depends on a number of factors. First, in order to satisfy heat balance requirements for the reactor, a certain minimum catalyst-to-oil ratio must be employed with very heavy stocks. This may be as much as twice that required for vapor-phase operation. Second, when heavy stocks are charged, particularly close-cut fractions, the ease with which such fractions are cracked results in a high level of conversion to useful products. This, of course, is highly desirable from the standpoint of economic considerations. Such operations generally result in greater coke laydown than is normal with light-stock cracking at somewhat lower conversions, and higher catalyst-to-oil ratios are frequently helpful in maintaining the catalyst mass at a satisfactory activity level. Third, it is desirable to maintain the coke distribution on the catalyst within desired limits to facilitate the operation of the regenerating kiln. Thus, a plant operating on a light stock at a lower conversion level may circulate 100 tons of catalyst per hour per 10,000 bbl. per day of oil charge with a resultant coke deposit of 5,000 lb. per hour, or 2.5 per cent by weight of the catalyst mass. Such a unit would employ a 10-zone regenerating kiln. A 10,000-bbl.-per-day unit, charging heavy liquid for high conversion operation, might form in the neighborhood of 10,000 lb. of coke per hour when 200 tons of catalyst

*Research and Development Laboratories, Socony-Vacuum Oil Co., Inc., Paulsboro, N. J.

†Houdry Process Corp. of Pennsylvania, Marcus Hook, Pa.

Editor's note—For several figures illustrating various points in this article see The Oil and Gas Journal, June 2, 1945, p. 84.

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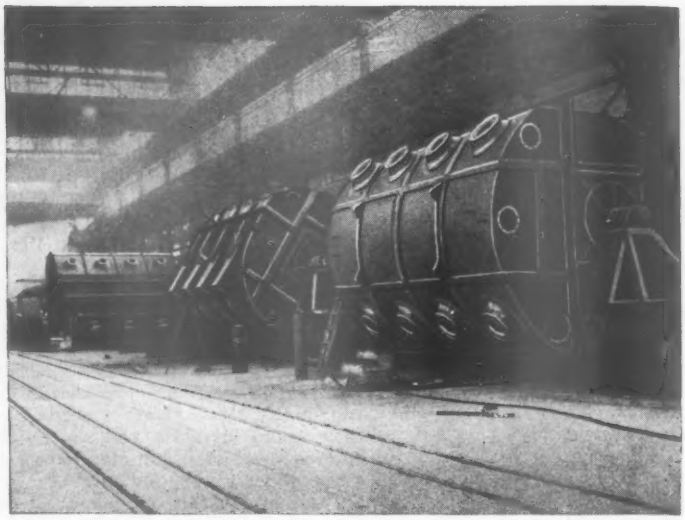

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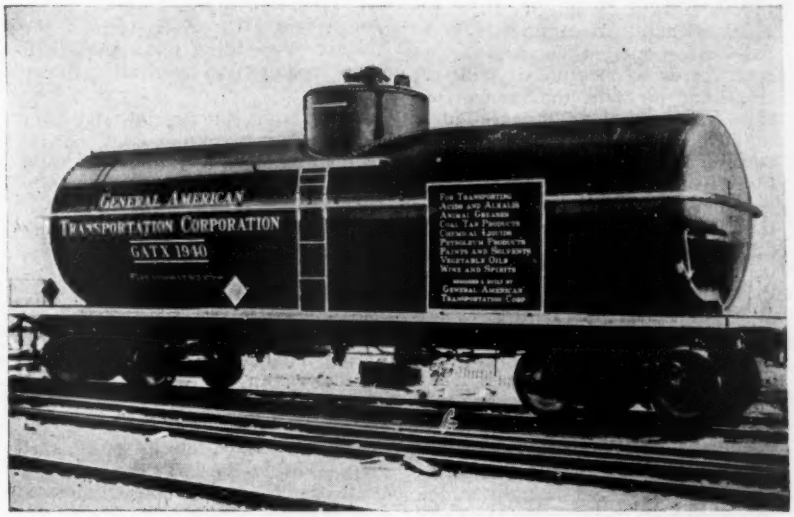

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per hour are circulated to maintain conversion at the desired level. Thus, in the latter case, there would be twice the weight of coke to burn, but the per cent (2.5 per cent by weight) of coke deposited on the catalyst mass would be the same, and the number of zones in the kiln would be the same as for the lighter-oil operation. This comparison is, for the sake of brevity, somewhat simplified, but it serves adequately to demonstrate the point in question.

The reactor used for liquid-charge technique is the concurrent solid-bed downflow type. Reactors of this type have been used in commercial vapor-phase operations, although most of the units now in operation use countercurrent upflow of vapors—the flow of catalyst being downward by gravity in either case. Without attempting to compare the merits of concurrent and countercurrent reactors, it will suffice here to state that concurrent flow has several advantages when liquid charge is employed, and has been adopted as the standard type for this technique. Two principal problems are involved in charging liquid to such a system: (1) Introducing the liquid onto the catalyst in uniform fashion; (2) removing the vapors from the catalyst mass at a point near the bottom of the reactor. The latter problem has been fully developed and proved on concurrent-flow vapor-phase reaction systems, and the same methods will be employed in the liquid-charge systems.

Basically, these vapor collectors are simply inverted troughs which are assembled in the form of a grid covering the cross-section of the reactor. Catalyst flow passages are provided between the troughs, and the vapors are released from the catalyst in the free space under the open side of the trough, and they then flow out through a side outlet to the fractionating section of the unit. Gas-collecting systems operating on this same principle are also employed successfully for collecting flue gas in numerous operating kilns in existing T.C.C. units.

The liquid distributing system at the top of the reactor has been thoroughly tested and demonstrated in pilot-plant and test model units. Tests of several months or more have been made without plugging or coking of the distributing elements employed.

Experimental work has shown that the catalytic reaction starts and proceeds extremely rapidly the instant the spray meets the catalyst. For example, it has been demonstrated that, in cracking a 25 per cent Mid-Continent crude residuum, about 75 per cent of the charge is converted to material having a lower boiling range than the initial boiling point of the charge stock at a point representing only 12 per cent of the total path through the reaction zone. Similarly at this point about 70 per cent of the ultimate gasoline formation has occurred, and only 0.7 per cent of the original feet can be accounted for as residual oil on the catalyst. These results are mentioned at this point simply to emphasize the extremely rapid conversion which occurs at the inlet zone of the reactor, and a more complete discussion of the progressive conversion throughout the reactor will be given later.

The liquid-charge technique can be employed in many ways: for example, either total liquid or liquid vapor feed may be charged directly to the reactor section, or alternately vapor and liquid may be introduced separately at the top of the reactor—depending upon the flexibility required in over-all refinery operation.

As to the commercial status of liquid-charge technique, it should be pointed out that commercial tests were delayed due to the necessity for keeping all T.C.C. units on full production on the aviation-gasoline program during the war. Today, one existing T.C.C. unit is being converted for liquid-charge operation, and will be in operation shortly. A second entirely new unit is under design, and should be erected during the coming year.

Processing Results

Typical charge stocks and catalysts.—Liquid-charge technique has been studied in the pilot plant on a wide range of charge stocks, varying from medium-boiling-range gas oils with their 50 per cent points at 700° F., to an asphaltic Duo-Sol tar extracted in the solvent refining of lubricating-oil stocks. Physical properties of four typical stocks on which considerable experimental work has been conducted are shown in Table 1. These comprise deasphalted 15 per cent East Texas residuum, 25 per cent undeasphalted Mid-Continent residuum, Kansas crude vacuum distillate, and a wide-cut East Texas flash distillate. It will be noted that none of these stocks would be considered as suitable for vapor-phase T.C.C. operation due to their high boiling range—the per cent distilled at 1,000° F. ranging from 24 per cent for the deasphalted 15 per cent East Texas residuum to 81 per cent for the wide-cut East Texas flash distillate.

Catalyst for liquid-charge operation may be synthetic bead, synthetic pellets, or pelleted clay; they are the same as those used in present conventional T.C.C. vapor-phase operations. Selection of catalysts for a given project will follow the same principles applicable to selecting catalyst for vapor-phase operations.

Representative yields.—In general, the yields of motor gasoline, coke, and heavy fuel oil are higher, and the yield of distillate fuel oil is lower, than from cracking light gas oils. yields of motor gasoline of 45 to 60 per cent by volume, of distillate fuel oil of 20 to 30 per cent by volume, and of heavy fuel oil of 10 to 20 per cent by volume are typical. Representative yields and operating conditions for processing the four charge stocks described hereinbefore over clay catalyst are presented in Table 2. At the operating conditions employed, the percentage of charge stock vaporized in the oil preheater varied from zero to about 50 per cent for the deasphalted 15 per cent East Texas residuum and wide-cut East Texas flash distillate, respectively.

Product quality.—The properties of catalytic products made from T.C.C. cracking of heavy stocks are normal in all respects. Motor gasolines have excellent volatility with C.F.R. motor-method octane ratings of 77 to 82 with a C.F.R. research octane ratings of 87 to 95. With the

TABLE 1—PROPERTIES OF TYPICAL T.C.C. LIQUID CHARGE STOCKS

	Deasphalted 15% East Texas residuum	25% Mid-Continent residuum	Kansas crude vacuum distillate	Wide-cut East Texas flash distillate
Gravity, °A.P.I.	23.2	21.2	22.3	26.4
Pour point, °F.	>120	85	110	>120
Sulfur, per cent by weight	0.39	0.46	0.61	0.38
Aniline No., °F.	234	220	205	207
Kinematic viscosity at 210° F.	26.4	34.8	13.8	8.0
Conradson carbon residue, per cent	1.6	4.5	1.3	0.9
Vacuum-assay distillation in °F.:				
	817	798	767	489
5 per cent point	933	831	808	631
10 per cent point	961	855	822	668
20 per cent point	992	881	840	729
30 per cent point	1,009	903	860	769
40 per cent point	1,032	940	880	810
50 per cent point	1,060	990	919	847
60 per cent point	1,106	1,020	950	888
70 per cent point	....	....	981	933
80 per cent point	....	....	1,029	999
90 per cent point	....	....	1,080	1,069
End point (approximate)	....	....	1,160	1,130
Recovery at 1,000° F., per cent	24	53	74	81

TABLE 2—YIELDS AND PROPERTIES OF PRODUCTS FROM T.C.C. LIQUID FEED CRACKING VARIOUS STOCKS OVER 90 ACTIVITY-INDEX CLAY CATALYST

Stock:	Deasphalted 15% East Texas residuum			25% Mid-Continent residuum			Kansas crude vacuum distillate			Wide-cut East Texas flash distillate	
Product:	Motor gasoline (10-lb. R.v.p.; 90% point at 357° F.)	Light fuel oil	Heavy cycle stock	Motor gasoline (10-lb. R.v.p.; 90% point at 356° F.)	Light fuel oil	Heavy cycle stock	Motor gasoline (10-lb. R.v.p.; 90% point at 351° F.)	Light fuel oil	Heavy cycle stock	Motor gasoline (10-lb. R.v.p.; 90% point at 365° F.)	Catalytic gas oil
Yield, per cent by volume	53.3	21.7	12.7	47.5	20.0	23.6	49.0	23.6	14.6	53.3	37.2
Gravity, °A.P.I.	60.0	26.9	14.4	61.1	26.4	18.5	60.7	23.8	11.4	57.5	21.0
R.v.p., lb.	10.1	....	....	9.8	....	....	9.8	....	....	9.7	....
Acid heat, °F.	116	....	....	156	....	....	129	....	....	156	....
Induction period, hours and minutes	15:45	....	....	8:00	....	....	13:20	....	....	....	....
Sulfur, per cent by weight	0.033	....	....	0.024	....	....	....	....	....	0.04	0.33
Aniline No., °F.	102	91	142	95	90	159	85	67	160	....	116
Pour point, °F.	....	<—35	85	....	<—35	80	....	—30	80	....	....
Distillation in °F.:	ASTM	ASTM	ASTM	ASTM	ASTM	Vacuum-assay	ASTM	ASTM	Vacuum-assay	ASTM	ASTM
Initial boiling point	90	432	622	102	450	669	86	422	670	102	460
5 per cent point	104	462	652	116	476	694	108	454	690	120	495
10 per cent point	113	468	668	126	482	710	120	460	693	136	504
20 per cent point	134	477	684	144	490	723	144	470	703	161	525
30 per cent point	164	486	694	170	501	740	170	482	726	188	550
40 per cent point	199	499	702	200	510	767	200	496	741	222	570
50 per cent point	236	512	712	234	520	796	233	512	752	236	590
60 per cent point	266	531	724	262	532	823	260	529	770	262	612
70 per cent point	295	543	734	292	548	853	288	547	792	298	640
80 per cent point	326	564	748	322	568	890	317	568	820	330	680
90 per cent point	357	587	....	356	588	940	351	592	914	365	720
End point	389	612	....	388	618	....	397	624	943 at 93 per cent Cracked	408	732
Recovery, per cent by volume	97.5	99.0	....	98.0	99.0	....	98.0	98.5	Cracked	98.0	Cracked
Loss, per cent by volume	1.5	....	....	1.1	....	....	1.0	....	....	1.0	....
Octane No.:											
C.F.R. motor method:											
Without TEL addition	77.4	....	....	78.2	....	....	78.4	....	....	79.0	....
With addition of 1 ml. per gal. TEL	82.9	....	....	82.7	....	....	82.8	....	....	83.2	....
With addition of 3 ml. per gal. TEL	85.4	....	....	84.8	....	....	84.7	....	....	....	....
C.F.R. research method:											
Without TEL addition	88.2	....	....	89.2	....	....	90.4	....	....	91.1	....
With addition of 1 ml. per gal. TEL	93.0	....	....	93.6	....	....	94.5	....	....	94.9	....
With addition of 3 ml. per gal. TEL	95.2	....	....	96.3	....	....	96.9	....	....	....	....

addition of 1 ml. of tetraethyl lead per gallon, the octane ratings of the motor gasoline are raised three to five numbers by both methods of rating. Light distillate fuel oils (630° F. end point) made from waxy high-pour-point charge stocks have a pour point below 0° F., usually in the range of —10° to —30° F. Heavy cycle stocks (made from charge stocks boiling predominately above 900° F.) have their 50 per cent points at 700° to 800° F. and their 90 per cent points below 900° F. Table 3 gives typical properties of motor gasoline, distillate fuels, and heavy fuel oils obtained from processing the charge stocks noted previously.

Operating variables.—The operating variables, and the range through which these variables have been studied, are as follows:

Oil inlet temperature, °F.	700 to 950
Catalyst inlet temperature, °F.	900 to 1,100
Catalyst-to-oil ratio, volume	1.8 to 6.0
Space velocity, V/V/hour*	0.4 to 6.0
Steam, per cent by weight	5 to 10
Pressure, psig.	10

*V/V/hour = ratio of the volume of liquid oil charged per hour to the apparent volume of catalyst in the reaction bed.

Inasmuch as the first three variables govern the heat supplied to the reactor, they exert a major effect on the severity of the cracking operation. It has been found that a total sensible heat input above 700° F. equivalent to 400 to 450 B.t.u. per pound of oil charge is required in the combined entering oil and catalyst streams to give an oil-free spent catalyst from the reactor when a stock is charged which has a substantial portion boiling above 900° F.

Catalyst-to-oil ratios need not be high in order to achieve the desired conversion with reasonable oil and catalyst inlet temperatures. Studies made on a number of stocks have proved catalyst-to-oil ratios in the order to 1.8 to 4.0 by volume to be adequate. For example, on the wide-cut East Texas flash distillate with oil and catalyst inlet temperatures of 850° and 1,100° F., respectively, the optimum catalyst-to-oil ratio appears to be between 3 and 4, as shown by the data in Table 4. At higher catalyst-to-oil ratios, such as 6.0, overcracking occurs which results in a rapid increase in coke

TABLE 3—TYPICAL OPERATING CONDITIONS AND YIELDS

Stock:	Deasphalted 15% East Texas residuum	25% Mid-Continent residuum	Kansas crude vacuum distillate	Wide-cut East Texas flash distillate
Catalyst:	30* AI clay	30 AI clay	30 AI clay	30 AI clay
Operating conditions:				
Oil inlet temperature, °F.	825	906	872	850
Catalyst inlet temperature, °F.	1,000	1,029	1,105	1,000
Average reactor temperature, °F.	870	915	926	920
Space velocity, V/V/hour	0.72	0.99	0.72	0.96
Catalyst-to-oil ratio, volume	5.2	4.0	3.8	4.4
Steam, per cent by weight of charge	5.4	5.1	5.0	10.6
Reactor pressure, psig.	10	10.5	11	10
Yields:				
Motor gasoline (10 lb. R.v.p.; 90 per cent point at 356° F.), per cent by volume	53.3	47.5	49.0	53.3
Excess C_4 above 10 lb. R.v.p. motor gasoline, per cent by volume	9.9	5.9	8.0	7.7
Catalytic gas oil, per cent by volume	34.4	43.6	38.2	37.2
Liquid recovery, per cent by volume	97.6	97.0	95.2	98.2
Dry gas (C_2 and lighter), per cent by weight	8.2	7.0	9.5	7.0
Total coke deposit, per cent by weight	8.0	8.5	7.0	6.4
Total coke deposit, lb. per hour on 10,000-bbl. per day feed	10,700	11,460	9,420	8,470

*AI = activity index.

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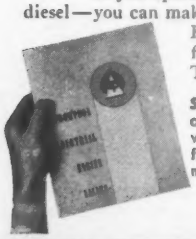

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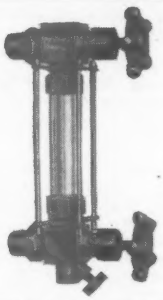

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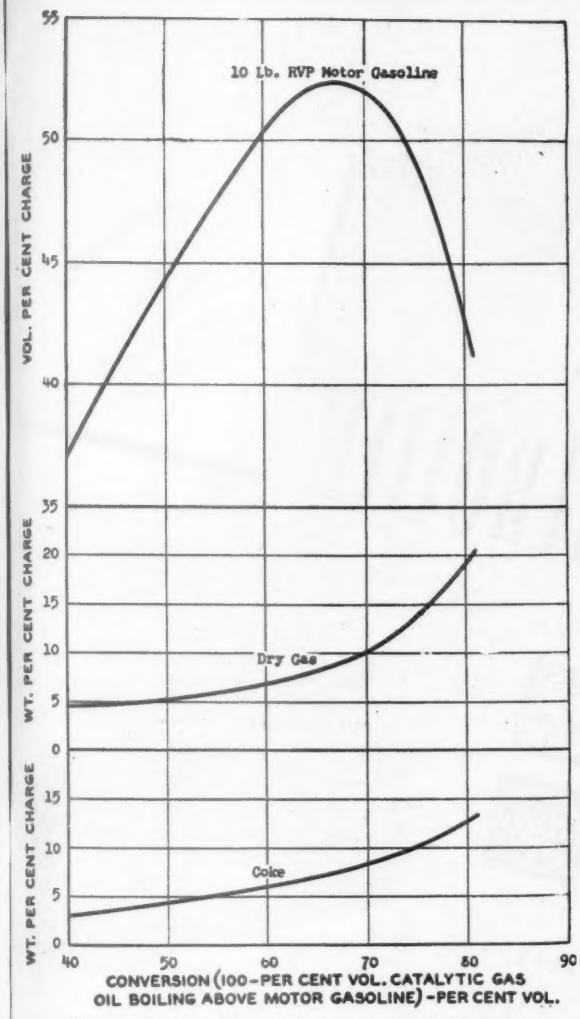
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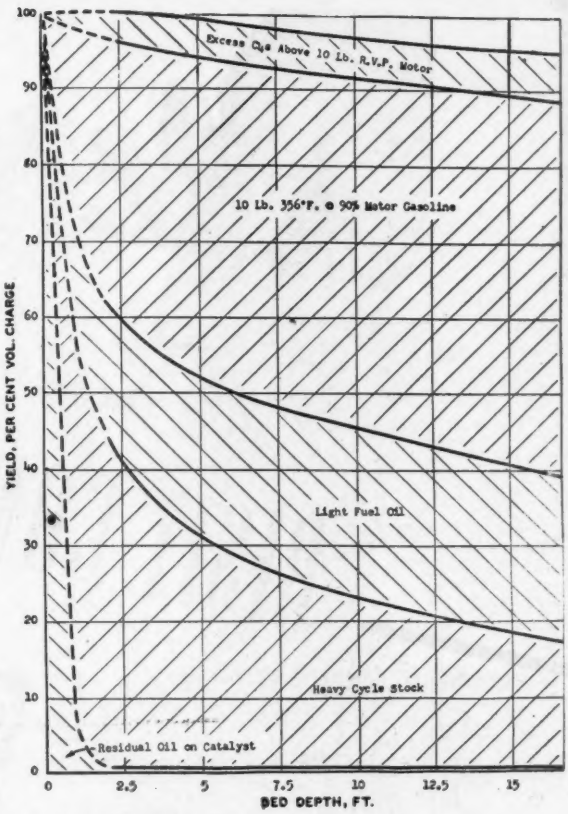
WT. PER CENT CHARGE
WT. PER CENT CHARGE
CONVERSION (100 - PER CENT VOL. CATALYTIC GAS OIL BOILING ABOVE MOTOR GASOLINE) - PER CENT VOL.

Charge stock: wide-cut East Texas flash distillate.
Catalyst: 30 AI clay.

Fig. 1—Yield of motor gasoline, dry gas, and coke as a function of conversion


Excess C4s Above 10 Lb. R.V.P. Motor
10 Lb. 356°F. @ 90% Motor Gasoline
Light Fuel Oil
Heavy Cycle Stock
Residual Oil on Catalyst
YIELD, PER CENT VOL. CHARGE
BED DEPTH, FT.

Catalyst: 29 AI clay.
Catalyst-to-oil ratio: 2.9 W/W.*
Oil inlet temperature: 900° F.
Catalyst inlet temperature: 1,025° F.
Steam: 5 per cent.

*W/W = ratio of the weight of catalyst circulated to the weight of oil charged.

Fig. 2—Product distribution vs. bed depth for liquid-charge T.C.C. cracking 25 per cent Mid-Continent crude bottoms

and gas with a loss in gasoline yield and liquid recovery.

A correlation of product yields with conversion for all the data on the wide-cut East Texas flash distillate is shown in Fig. 1. This correlation is based on data in which the oil inlet temperature was varied from 700° to 850° F., the catalyst inlet temperature from 1,000° to 1,100° F., and the catalyst-to-oil ratio from 1.8 to 6.0 by volume. This demonstrates the flexibility of this type of processing, as it reflects the interchangeability of the process variables to achieve a desired conversion level. On this stock, the maximum yield of 52.5 per cent of motor gasoline, with a Reid vapor pressure of 10 lb. and with a 90 per cent point at 365° F., is obtained at about 67 per cent conversion, with a yield of 9.0 per cent by weight of dry gas (C_2 and lighter) and 7.0 per cent by weight of coke.

The progressive change in liquid-product yields with bed depth while cracking the 25 per cent Mid-Continent crude bottoms over 30-activity clay catalyst is shown in Fig. 2, with the results expressed in terms of equivalent bed depth for a 16-ft.-diameter 10,000-bbl.-per-day commercial reactor. Substantially all the liquid is cracked off the catalyst in the first 2 ft. of bed depth; furthermore, 70 per cent of the ultimate gasoline yield is obtained at this level, and the change in product distribution throughout the remainder of the reactor is relatively slow. Product yields at the 2-ft. and 17.5-ft. levels are as follows:

Yields based on charge—	2-ft. level	17.5 ft. level
Motor gasoline (10-lb. R.v.p.; 90 per cent point at 365° F.), per cent by volume	34.6	49.1
Excess C_4's, per cent by volume	4.2	6.6
Distillate fuel oil, per cent by volume	16.4	21.8
Heavy fuel oil, per cent by volume	44.6	17.7
Dry gas (C_2 and lighter), per cent by weight	4.2	8.3
Oil on catalyst, per cent by weight	0.7	0.2
Net carbon deposit, per cent by weight	5.8	8.9

TABLE 4—EFFECT OF CATALYST-TO-OIL RATIO

Stock:	Wide-cut East Texas flash distillate			
Catalyst-to-oil ratio, volume	1.9	2.9	4.6	6.0
Motor gasoline (10-lb. R.v.p.; 90 per cent point at 365° F.), per cent by volume	40.9	45.2	51.4	43.9
Excess C_4 cut above motor gasoline, per cent by volume	3.2	6.0	11.3	14.5
Catalytic gas oil, per cent by volume	56.5	47.7	33.1	19.2
C_4 free liquid recovery, per cent by volume	100.6	98.9	95.8	77.6
Dry gas (C_2 and lighter), per cent by weight	4.4	6.7	9.3	20.5
Coke, per cent by weight	3.4	3.9	7.1	13.2
Coke, lb. per hour on 10,000-bbl.-per-day feed	4,500	5,120	9,220	17,350

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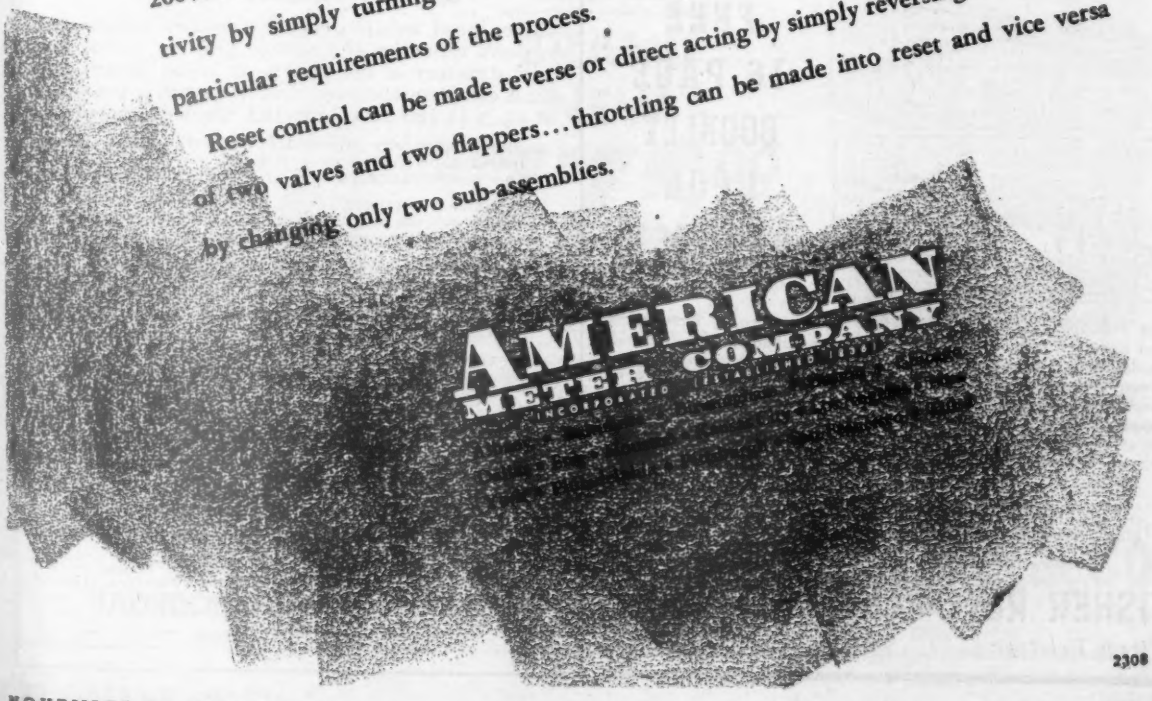

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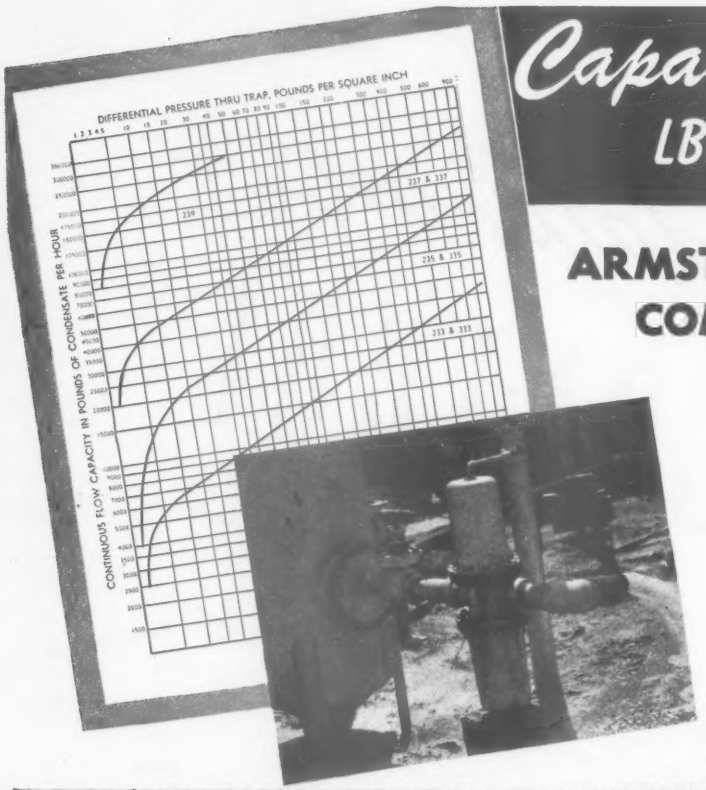
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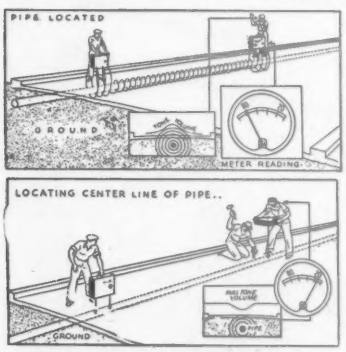

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TABLE 5

Stock—	Deasphalted 15 per cent East Texas residuum	Mid-Continent 25 per cent crude bottoms	Duo-Sol tar
Conradson carbon residue, per cent by weight	1.6	4.5	13.0
Conversion,* per cent by volume	57.4	57.4	57.4
Coke laydown, per cent by wt.	6.5	10.5	28.0
Coke laydown, lb. per hour on 10,000-bbl.-per-day feed	8,700	14,100	41,500

*Conversion 100 = minus per cent by volume of catalytic gas oil boiling above motor gasoline.

TABLE 6

	Raw East Texas residuum	Deasphalted East Texas residuum
Motor gasoline (10 lb. R.v.p.; 90 per cent point at 356° F.), per cent by volume	34.1	53.3
Excess C_4's above motor gasoline, per cent by volume	5.1	9.9
Distillate fuel oil, per cent by volume	22.1	21.7
Heavy fuel oil, per cent by volume	25.0	12.7
C_3-free liquid recovery, per cent by volume	86.3	97.6
Dry gas (C_2 and lighter), per cent by wt.	7.1	8.2
Coke, per cent by weight	18.4	8.0
Coke, lb. per hour on 10,000-bbl.-per-day feed	25,700	10,700

The relatively high carbon laydown associated with high-conversion liquid-charge technique on heavy stocks as compared to normal operation on lighter gas oils is due to the character of the charge rather than to the fact that the charge is a liquid when it contacts the catalyst. For example, on a stock which could be charged either completely as a vapor as as about 50 per cent liquid there was no noticeable difference in carbon laydown or product distribution when the total heat input to the reactor was held the same.

Reduced crudes or residuums should be deasphalted to give Conradson carbon residues below about 4 per cent by weight before they are cracked in order to maintain the coke laydown at reasonable levels. The effect of Conradson carbon of the charge stock on the coke laydown is shown in Table 5.

The advantage of removing asphalt from the charge prior to cracking is not only confined to considerations of carbon burning requirements, but also is reflected in greatly improved yields of motor gasoline for a given catalytic cracking capacity. This is illustrated by comparable data from cracking an 11.6 per cent by weight carbon residue raw East Texas 15 per cent residuum and a 1.6 per cent by weight carbon residue deasphalted East Texas 15 per cent residuum (Table 6).

Deasphalting may be accomplished by an conventional method such as vacuum distillation, flash distillation, or solvent deasphalting; selection of the process will depend on the economics for the particular installation under consideration. On low-carbon-residue crudes, where deasphalting may not be necessary from the standpoint of carbon laydown, it will, nevertheless, be necessary to give the charge to the catalytic unit some treatment to remove inorganic salts or other nonvolatile materials which might be harmful to the catalyst.

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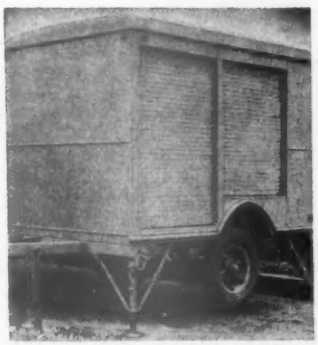

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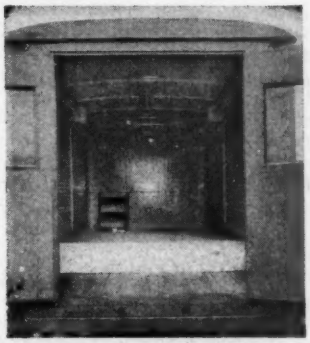

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Fluid Flow

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6—Thermodynamics of Gas Flow

by Paul Buthod and B. W. Whiteley

DURING the past few decades the flow of gases at high pressures has become increasingly important. Operating conditions such that gases deviate considerably from ideal behavior have necessitated a new analysis of factors which may affect the design of equipment.

In the case of liquids flowing through pipes, changes in fluid density are negligible. In addition, kinetic-energy changes are usually small and for many purposes may be entirely disregarded.

This simple behavior of liquids contrasts sharply with the flow of gases where the large number of variables requires a detailed analysis of both mechanical and thermal effects.

In order to simplify the analytical solutions of gas flow, isothermal conditions are usually assumed. This is the basis of Weymouth's and other semiempirical formulas which have been widely used. Obviously, isothermal flow conditions are closely approached in the case of long lines which are not insulated. At the opposite extreme, are insulated pipes with large pressure drops where adiabatic flow conditions are approached. It is of interest to note that isothermal and adiabatic flow conditions give results which usually do not differ by more than 10 or 20 per cent.[5] Since isothermal flow results in a larger pressure drop, other factors being equal, such an assumption gives conservative answers.

Of growing importance in modern processing are instances such that the gas is either heated or cooled as it flows through the pipe. Analysis of such conditions usually requires a large amount of ingenuity and computation.

It will be noted from the foregoing discussion that the effect of temperature changes has been emphasized. As a matter of fact, if the temperature gradient is known along the length of the pipe, then the analysis of gas flow resolves into the familiar problem of finding pressure drop, quantity of gas, or length of line if any two of these three variables are known.

Due to the many complicating variables, it is usually not possible to describe analytically the flow of gas as simply as that of liquids. Despite the fact that the flow of compressible fluids requires analytical expressions in the differential form, such equations for most practical purposes may be simplified and as such require but little more effort or skill in use than those for liquids.

Discussion in the preceding article (November 17 issue) of this series was on pressure drop in fittings. Covering a wide range pipe sizes and a number of different valves and fitting types, the chart (Fig. 5-1), which was included with Article 5, is plotted in terms of equivalent pipe lengths for turbulent flow and for values of actual pipe diameters. An example, which illustrates how some of the charts in the previous articles may be employed to solve practical problems, was included as a part of the discussion.

General Equations for Fluid Flow

In the flow of any fluid there are certain physical laws which must be satisfied. For use in deriving expressions for gas flow, and interpreting any physical or thermal effects, these basic laws are expressed in mathematical form.

For instance the law of conservation of energy requires that the algebraic sum of all mechanical and heat energy effects be zero. When applied to fluid flow, and using 1 lb. of the material as a basis, this may be expressed as:

$$JdE + dy + pdv + vdp + \frac{u\,du}{g} + dw_s - Jdq = 0 \qquad (6\text{-}1)$$

where the symbols are explained in the accompanying notation. Equation 6-1 relates the energy changes involved in the flow of any fluid to the thermodynamic variables of state. It does not give any information concerning the mechanism of flow or extent of friction losses, although it does indicate the ultimate form of such losses.

From thermodynamics:

$$dq = dE + \frac{dw}{J} \qquad (6\text{-}2)$$

and

$$dw \leqq pdv$$

where the equality is true only for a reversible process. However, the flow of fluid through a pipe is highly irreversible, and in this instance, "dw" is less than "pdv" by the amount of any frictional effects which are involved, or:

$$dw = pdv - dF \qquad (6\text{-}3)$$

Substituting Equations 6-2 and 6-3 in 6-1, there results:

$$dy + vdp + \frac{u\,du}{g} + dF + dw_s = 0 \qquad (6\text{-}4)$$

Equation 6-4 contains only mechanical energy terms and is the basis for calculations involving the flow of fluids through pipes. The "dF" term indicating the energy loss due to friction in straight pipe, is identical with the loss in head as defined by the Darcy equation and may be written:

$$dF = dh_f = \frac{f\,u^2\,dl}{2gd} \qquad (6\text{-}5)$$

In addition to the above equations relating the energy effects, it is also necessary to specify that the flow be one of steady-state conditions, or in other words that the mass rate of flow be independent of both time and location of the cross-section chosen.

$$u_1\rho_1 = u_2\rho_2 \qquad (6\text{-}6)$$

This is usually referred to as the equation of continuity and in simple terms states that for every pound of fluid flowing into a section, an equal weight must flow out of the end section.

The foregoing equations completely describe the flow of fluids through closed conduits. Equation 6-1 indicates the ultimate form of any energy changes which occur, while Equation 6-4 relates physical changes which take place during the process. Equation 6-5 gives the magnitude of the friction loss and Equation 6-6 restricts the flow process to steady-state conditions. While

these equations have necessarily been stated in differential form, in succeeding articles and for practical applications, they will for the most part be given in an integrated form, suitable for the particular type of flow problem involved.

Equation 6-1 may be used immediately to investigate the energy changes involved in the various types of flow. Using the relation:

$$dH = dE + \frac{d(pv)}{J} \qquad (6\text{-}7)$$

Equation 6-1 may be rewritten in a form more convenient for present purposes as:

$$dH + dy + \frac{u\,du}{g} + dw_o = dq \qquad (6\text{-}8)$$

Isothermal Flow

For isothermal fluid flow in a horizontal pipe and assuming no external shaft work is involved, then:

$$dw_o = 0$$

and

$$dy = 0$$

and upon integrating Equation 6-8.

$$q = \frac{u_2^2 - u_1^2}{2g\,J} + (H_2 - H_1) \qquad (6\text{-}9)$$

where the Subscripts 1 and 2 indicate conditions respectively at entrance and end of the section under consideration. Since a pressure drop will always exist in a horizontal pipe, u_2 will be greater than u_1 and the first term on the right side of Equation 6-9 will be positive. For ideal gases, there is no isothermal change in enthalpy and for such a case the second term is zero. However, for all real gases, an isothermal reduction in pressure results in a change in enthalpy and within the range of pressures encountered in practice, the enthalpy of hydrocarbon gases increases for such conditions.

Consequently, the net energy effect for isothermal flow in a pipe is an influx of heat into the line in such amount as to supply the increase in velocity head and the increase in enthalpy of the gas. For usual conditions encountered in practice, the amount of heat supplied by the surroundings is small. However, at high rates of flow such that large pressure drops are involved, there may be insufficient transfer of heat into the pipe and an appreciable temperature drop may occur along the length of the line. In such instances, the flow path lies between isothermal and adiabatic conditions.

Adiabatic Flow

For adiabatic flow conditions, there is no transfer of heat between the pipe and the surroundings. In actual practice, this condition corresponds closely with well-insulated lines. Assuming that no shaft work is involved and that the pipe is horizontal:

$$dq = 0$$

$$dy = 0$$

$$dw_o = 0$$

and integrating Equation 6-8:

$$H_1 - H_2 = \frac{u_2^2 - u_1^2}{2g\,J} \qquad (6\text{-}10)$$

For the usual conditions encountered in practice the term on the right-hand side of the above equation is small and consequently there is only a slight change in enthalpy, which in most costs is negligible. Thus, adiabatic flow in a long line is essentially a Joule-Thomson expansion or a constant enthalpy process. It is worth noting that adiabatic flow in a pipe has nothing in common with a constant entropy process which denotes complete reversibility. As a matter of fact, if the flow process were isentropic, there would be no friction loss involved.

General Flow Paths

Although isothermal and adiabatic flow are limiting cases which may be closely approached, there are frequent instances such that neither of the two processes describes adequately the type of flow. Practical examples are the cooling or heating of gases flowing through pipes and where large temperature changes may be involved. For horizontal pipes and assuming no shaft work, Equation 6-8 becomes:

$$q = \frac{u_2^2 - u_1^2}{2g\,J} + (H_2 - H_1) \qquad (6\text{-}11)$$

which is identical with the equation for isothermal flow. However, for the general flow path, the heat

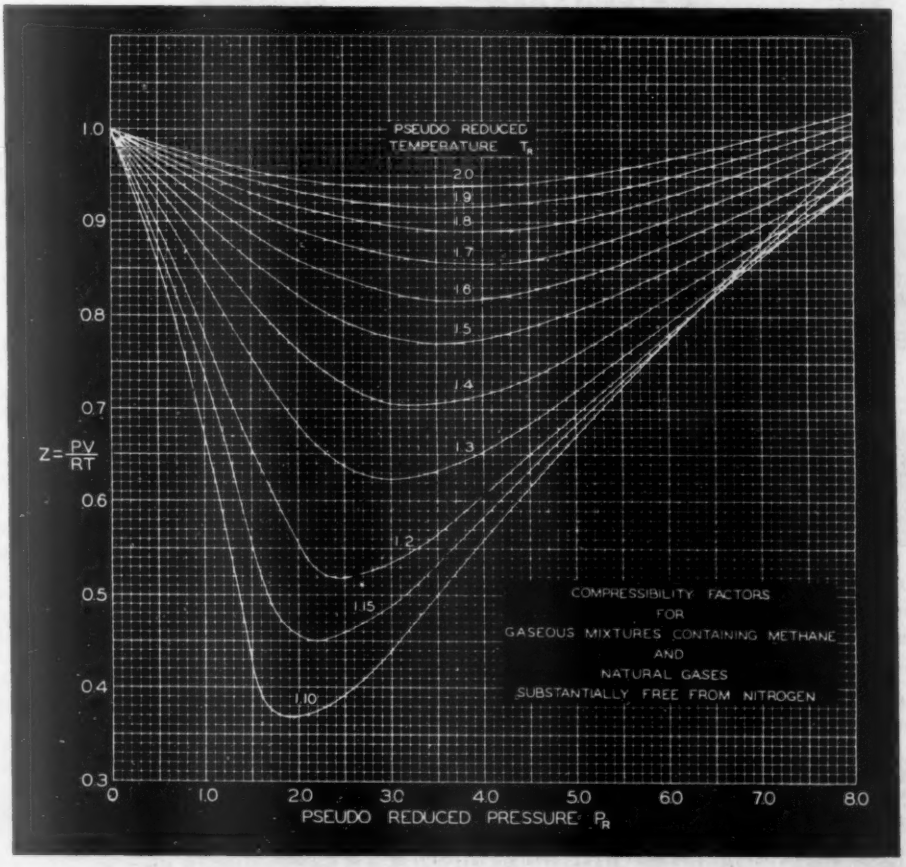

Fig. 6-1

added or taken from the gas must be such as to balance the temperature gradient along the length of the pipe. This temperature gradient can be determined from the foregoing equations together with heat-transfer data. The actual calculations, however, are frequently quite tedious, and make considerable demands on the technical skill of the engineer who employs them.

Gas Behavior

In all the foregoing discussion, it has been assumed that the P-v-T behavior of the gas could be adequately defined either by means of an equation of state or by compressibility factor charts. At present-day operating pressures, hydrocarbon gases show considerable deviation from ideal behavior and the effect of compressibility should be taken into consideration. For most practical purposes the compressibility factor can be evaluated from generalized data such as the chart developed by Brown.[5] This chart is reproduced as Fig. 6-1.

After determining the compressibility factor "Z," the P-v-T behavior of the gas is defined by:

$$Pv = ZRT$$

The pseudocritical temperature and pressure can be obtained by means of gas gravity correlation charts or from an analysis of the gas.[5]

Notation:

- d = actual pipe i.d., ft.
- $\mathbf{d}$ = differential operator
- E = internal energy of fluid, B.t.u./lb.
- f = friction factor, dimensionless
- F = friction head, ft.
- g = acceleration due to gravity = 32.2 ft./sec.^{2}
- h_f = loss in head due to friction, ft.
- H = enthalpy of fluid, B.t.u./lb.
- J = conversion factor = 778 ft. lb./B.t.u.
- l = length of pipe, ft.
- P = pressure, psi.
- p = pressure, lb./ft.^{2}
- q = quantity of heat transferred (positive for heat supplied to system), B.t.u./lb.
- u = linear velocity, ft./sec.
- v = specific volume of fluid, cu. ft./lb.
- $\mathbf{v}$ = volume, cu. ft./lb. mol.
- R = universal gas constant = 10.73
- T = temperature, deg. Rankine
- w = general work term, ft. lb./lb.
- w_s = shaft work term (positive for work supplied to system), ft. lb./lb.
- y = elevation head, ft.
- Z = compressibility factor
- ρ = fluid density, lb./cu. ft.

Subscripts 1 and 2 = conditions at entrance and end of section under consideration.

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Robert W. Kerley has been named director of aeronautical research for Ethyl Corp. succeeding **S. D. Heron**, who will remain with Ethyl as a special consultant. Kerley has been a civilian engineer with the U. S. Army Air Forces at Wright Field, Dayton, since 1932 and chief of the fuel and oil branch, power-plant laboratory of the Air Technical Service Command since 1936. He is planning cooperative programs with manufacturers of aircraft engines and with oil companies for more effective utilization of aviation fuels. His headquarters will be at the Ethyl research laboratories in Detroit.

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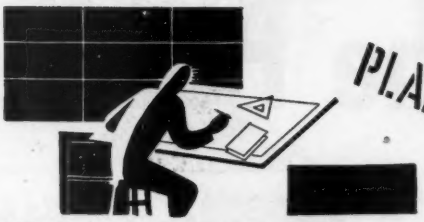

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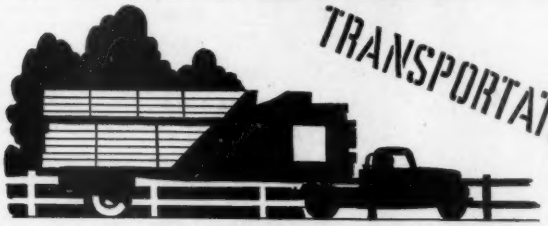

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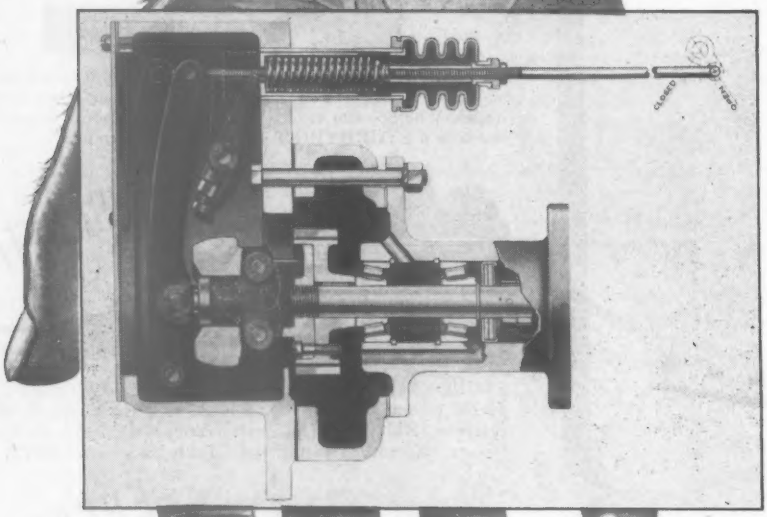

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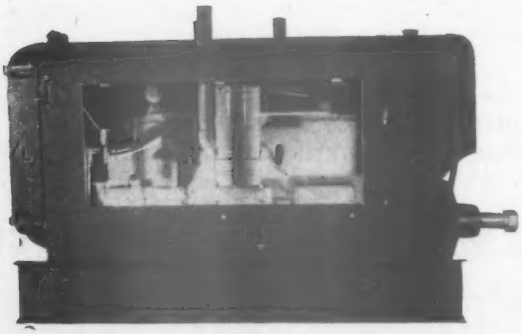

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No Peace for Fractionators

*by P. J. Harrington, B. L. Bragg, III, and C. O. Rhys, Jr.**

A.P.I.

ABSTRACT

The war has increased the amount of engineering research in the petroleum industry to improve the efficiency and capacity of refinery process unit operation equipment, such as fractionating towers, furnaces, heat exchangers, mixers and separators, compressors, and pumps. Examples of how this problem was approached in one company on one type of operation during the war are given. Minor changes in the internal structure of towers of representative prewar design increased atmospheric crude pipe-still throughputs from less than 30,000 bbl. per stream day capacity to 40,000 to 50,000 bbl. with excellent separating efficiency while representative light-ends fractionators for separating iso and normal butane were increased in limiting vapor loads from 20,000 bbl. per stream day to 45,000 at over 100 per cent plate efficiency. Extension of this type of engineering research is recommended.

AT the beginning of the war, the petroleum industry of this country had a very large investment in refinery-process units. Wartime construction added another sizable increment. Of the total, it has been estimated that some 25 to 30 per cent is in distillation-type equipment. Fractionation continues to be the basic operation in petroleum refining, figuring prominently in a wide variety of processes from crude distillation in shell and atmospheric and vacuum pipe stills through thermal and catalytic cracking steps with associated absorption and light-end recovery and separation units, to rerun stills, extractive and azeotropic distillation plants, and solvent extraction facilities. The newer blending agent operations for aviation and motor gasoline components, such as cumene, alkylate, polymer, and isomerization products, are quite dependent on efficient fractionation. Even the growing field of chemical byproducts from alcohols to additives, and from resins, plastics, and rubbers to solvents for them, involves this important process.

Long before the first world war, the theory of the separation of two, three, and multicomponent mixtures by fractionation had been established and a rather complete literature now exists upon the subject. Design engineers in this and other industries had established a basis for producing the equipment to do the job required. This art had, however, reached the stage where only a limited amount of further investigation seemed worth while. It was common practice on multicomponent mixture designs, such as those for crude stills where anything approaching superfractionation was not needed, to work from an empirical formula involving a so-called "critical" vapor velocity when sizing towers. This formula varied somewhat from company to company, but in essence involved the fundamentally sound principles controlling the fall of liquid droplets through rising vapors with one of those constants to tie in lack of proper use of theory with experience known to the initiate as "factors of ignorance." For number-of-plate requirements, experience was (and remains) the best guide. Where depropanizers, debutanizers, etc., were involved, plate-to-plate studies were often made assuming a 90 per cent plate efficiency as reasonably close to the 100 per cent which would, by definition, appear to be limiting. Even in such cases, a few extra plates were added as experience dictated. By and large, very creditable results were obtained by the design engineers.

The advent of the latest war accelerated a change which was already under way in tower design. At the same time that developments in aviation blending agents called for large-scale units capable of true superfractionation, the need for pure chemical compounds, such as toluene, butadiene, isoprene, and isobutane (to mention but a few), became imperative. Lack of time, materials, and manpower were coupled with a demand for increased crude runs to make well-fractionated virgin aviation base stocks and optimum quality gas oils for catalytic cracking. The most urgent new equipment called for extrapolating design formulas for 6 to 10-ft. crude towers to 12 to 18-ft. sizes. Light ends fractionators grew to 10 to 12-ft. diameters with 50 to as many as 150 plates and reflux ratios involving Niagara-like flows across them. As the war progressed, even these giants were called on for more and more output. Crude runs came up and cracking severity increased as the insatiable Ickes called for more fuel for the war machine.

The response of the industry to this demand is common knowledge and to single out the work of any one group can be justified only as a specific example on which to fasten a plea for continuing wartime engineering research, particularly in the important field of fractionation. For that reason, we have chosen two examples which point the way in the fields of crude and light-ends fractionators.

In the fall of 1941, Standard Oil Co. of New Jersey put into operation in its Bayway refinery two single-stage atmospheric crude pipe stills, each designed to reduce 28,000 bbl. per stream day of East Texas crude to 20 per cent bottoms, or 32,000 bbl. per stream day of West Texas crude to 30 per cent bottoms, making a variety of well-fractionated products from a light naphtha overhead to a heavy gas oil bottom side stream. The main towers with sections of 12 ft. 6 in. and 16 ft. 6 in. in diameter represented considerable extrapolation from previous company (and most industry) high liquid load towers. The reflux and pump-around rates for the required fractionation called for flows as high as 115,000 gal. per hour of hot liquid across the plates of these large towers. Gaps of 5° to 25° F. were expected, based on the 95 per cent and 5 per cent points of adjacent cuts.

Difficulties Encountered

In operation, difficulties were encountered with these units at less than design throughput, the fractionation being poor while trouble was encountered in withdrawing the refined oil side stream for product and a stream for cooling to induce reflux in the tower when returned as pump-around. After some study and attempts to improve operations by changing draw-off pan arrangements, it was concluded that some kind of liquid bypassing was occurring. Plate gasket leakage as a source of trouble was eliminated and "dumping" due to plate liquid inlet side bell-cap flow reversal became suspect.

It was decided to study the hydraulics of the tower plates with air and water and half of a spare plate was set up on a wooden box structure where air could be passed up through the section at varied rates while water was allowed to flow across it. An extensive program was carried out by the technical service division of Standard Oil Co. of New Jersey and Standard Oil Development Co. from which it was possible to develop quantitatively what had happened in the large tower. Valuable data for correcting the troubles encountered and for improving future design were obtained, including moving pictures

*Standard Oil Development Co., Elizabeth, N. J.

of normal, abnormal, and corrected flow conditions. The remedies for the trouble were evident once the difficulty was understood. Extremely simple changes were made to the large tower plates and it has since been possible to charge up to 45,000 bbl. per stream day of crude to these units, obtaining gaps between 95 per cent and 5 per cent points ranging from 20° to 35° F. on contiguous cuts. Furnace capacity is a limitation to the present feed rate. These results added in no small measure to Bayway's ability to perform outstandingly in producing war products.

In developments of this sort, it is evident that improvements are only possible as a result of the perfect cooperation of operating and technical people when studies of units pushed to their utmost are involved. In this case, great credit redounds to E. F. McTernan, Bayway Atmospheric distillation department head, for just that sort of cooperation.

Reviewing the water and air studies and much work undertaken since 1941, it is possible to reconstruct the Bayway crude still tower troubles rather completely. For the sake of brevity, the fitting together of the puzzle will be passed over and the composite outlined.

Dimensional Similarity Bugaboo

A first fallacy involved that old bugaboo of dimensional similarity which has so often caught the unwary. A mouse cannot be enlarged proportionately to become an operable elephant. Designs which operate perfectly when they are used for towers 6 ft. in diameter may run into trouble when scaled up directly to 16 ft. It has long been known and for years engineering students have been told that if one attempts to flow liquid across a bubble-cap tray, a liquid gradient is set up as is the case in a river and flow may back up and flood the tower. In practice, the student soon learns that in a few feet in a tower one can normally scarcely detect the liquid gradient even at heavy flow rates and that this gradient is negligible, compared to the usual downcomer height, so that the tower in practice does not flood from this cause.

On the other hand, novel troubles do develop in large towers at high flow rates, causing great difficulty. With vapor passing up through all of the Bayway crude-tower plate bubble caps, if the liquid flow across the plate is small, uniform and satisfactory operation results. As the liquid flow increases, the resistance due to the caps, to the vapor stream, and in the original tower, to the hold-down bars on the bubble cap rows (transverse to the liquid flow) establish a gradient which may eventually amount to from one to several inches of flowing liquid. In a 16-foot tower, even this may seem small. The average tower, however, has in the past contained as many caps as could conveniently be fitted in to improve vapor distribution and contact and these have been designed for minimum reasonable pressure drop. The drop through such caps may be from one to several inches of flowing liquid equivalent. Now, if the head on the liquid inlet side of the plate caps, due to an "insignificant" liquid gradient, is greater than that on the liquid outlet side of the plate caps, and if this differential head is of the same order of magnitude as the small pressure drop through the caps, vapor flow will be reduced and finally stopped through the liquid inlet side caps as the liquid gradient increases.

Maldistribution of Vapor Flow

Note that overflow weir height, plate spacing, or average depth of liquid on the tray, do not, in themselves, affect this maldistribution of vapor flow. The important ratio is that of the plate liquid gradient to the cap pressure drop. At a given vapor loading, as more and more inlet side caps are blanked off by rising gradient as liquid flow increases, pressure drop through the fewer and fewer active vapor-loaded caps increases to tend to stabilize the tower operation. Since vapor loading normally increases with liquid loading (constant feed and product rates with increased heat input increasing vapor loading and reflux rate), a further stop to extreme blanketing usually exists. Despite these brakes, if excessive liquid loading is built up, the head of liquid on the liquid inlet side plate caps will exceed the average plate cap pressure drop (even though this has increased as blanking takes place) and liquid will spill down through the inlet side caps to bypass the plate and to affect adversely the fractionation. If a liquid sidestream product or pump-around draw-off is located at the outlet of a plate so by-passed, a very limited amount of draw-off is possible.

It should be pointed out that the phenomena outlined differ from "flooding" as usually defined where a tower "pukes" or will not pass the liquid charged to it. A "dumping" tower may give no external evidence of abnormal operation, especially if no large sidestream withdrawals are attempted. Many towers giving even tolerably good fractionation by the standards of experience for such towers may be "dumping" and thus losing fractionation.

As will be discussed below, gradients may become so high as to back up liquid to the top of the downcomer and so actually "flood" the tower. This is most likely where plate spacing is too close; overflow weirs too high or weir length too short; or downcomer submerged weirs are too short, too close to the plate, or partly obstructed by first-row caps. Combinations of these troubles may cause flooding or complications may be introduced by vapor cross-flow, as discussed below. The Bayway crude pipe stills did not "flood," but did "dump" badly.

To discover a cause is to make remedy less difficult. The causes of "dumping" are: (1) Too long a liquid path; (2) low cap pressure drop; and (3) excessive resistance to liquid flow across the plate. Multipass plates reduce liquid path length but have some other disadvantages such as the possibility of maldistribution between passes. This occurred in one Jersey company affiliate's three-pass tower. For large towers and high liquid rates, excessive gradients may be set up on each pass. Multipass replacement plates are also more expensive than other remedies for most existing towers.

Cap pressure drop may be increased where excess tower pressure is available by lowering average operating pressure or by modifying cap layout or design. The former alternative also improves the relative volatility of the lighter components compared to the heavier and this is an advantage in improving separation or reducing reflux rate up to the point where true vapor velocity limitations due to spray entrainment from properly balanced plates with uniform vapor distribution are encountered. Condenser conditions may, in other cases, be limiting.

Cap Pattern

Caps may be replaced by others designed for greater pressure drop or chokes may be installed in existing chimneys. Blanking certain caps in a properly chosen pattern will be effective as will wider cap spacing in replacement or new plate design. If the cap pattern is identical over the plate, a remedy for the troubles outlined is effected, but if caps are redesigned, blanked, choked or more widely spaced on the liquid outlet side of the plate than on the inlet side, a better operation results, as will be discussed below. By using higher chimneys or chimney extensions on the inlet side of the plate, compensation for full rate gradient may be provided. Sloped or stopped plates have also been proposed for this purpose. Such expedients have evident disadvantages (which may not be serious) at low tower throughputs.

Considering liquid flow resistance, cap hold-down bars placed transverse to liquid flow, are the chief offenders. A few ½-in. or even 1½-in. bars may seem insignificant in a scale drawing or on inspection of a 15-ft. diameter tower with 3-ft. plate spacing, but in terms of liquid flow

path they can have much the same effect as the Notre Dame line would have on an aspiring high school halfback. In passing, it may be noted that hold-down bars paralleling the liquid flow are not favored lest they tend to cause maldistribution of liquid in the plane normal to its flow. While the only partially explored problems associated with this type of liquid channelling will not be detailed herein, it is evident that such channelling can seriously interfere with good fractionation without tower flooding or dumping and should be avoided by careful attention to peripheral cap placement; inlet and outlet weir shape, height, location, and clearance; and by care in locating charge and product lines.

Cap Shape

Cap shape influences resistance somewhat and "streamline" caps have been proposed, but with high flow rates submergence minimizes this resistance for normally rounded caps. Cap pitch must be watched to avoid a pattern of vapor jets which tends to obstruct liquid flow at high vapor rates while promoting localized excessive spray height and poor over-all liquid-vapor contact. Another of many resistance-reduction proposals involves specially designed caps with vapor slots so arranged as to blow or pump liquid across the plate, augmenting flow and minimizing gradient by a limited cross "air-lift" or vapor-jet action.

Soon after the Bayway crude pipe stills had achieved the successful operation outlined above, a large atmospheric rerun pipe still which had been under construction while the crude still troubles were being eliminated, came into operation at that refinery. In its initial run, a new phenomenon was encountered which the crude still and air-and-water studies did not explain. At high throughputs a surging action seemed to take place in a regular cyclic manner. A rush of liquid through the downcomers was clearly audible at about 2-minute intervals and this period appeared to be as regular, as immutable, and at least sounded as torrential as Old Faithful itself. The sidestream draw-off from the surging plates when opened wide varied through the cycle from a full stream to a trickle.

To study this new difficulty, recourse was had to glass-paneled ports in the tower through which internal conditions could be observed. These had been discussed in connection with the crude towers, but only became necessary to study rerun tower surges. Operating management again showed commendable cooperation in permitting installation of these untried devices, which appeared less foolproof than calculations would have them. However, in operation they were quite successful, not only on low-pressure towers, but subsequently on 100-lb. isobutane towers. Consisting of two tempered pyrex blanks 6 in. in diameter with ground gasket surfaces installed in flange-type fittings on manhead covers, one was used as a spotlight port while observations were made through the other. Excellent visibility entirely across the tower and for a considerable part of the space from downcomer to overflow weir was possible. Later scales were installed within the tower to assist in estimating liquid levels and spray heights and subsequently quite satisfactory moving pictures of the multi-pass tower mentioned above were made through such ports by St. Clair Processing Corp., of Canada, including photographs of surges in that tower.

Situation Emphasized

The observation ports emphasized a situation which had been hypothecated as a result of the earlier studies but which had not been fully evaluated. The air-and-water installation had one serious shortcoming in that only one plate was used. If a second had been superimposed on the first, as is the case in a tower, with liquid flowing in the opposite direction from that on the lower plate, an occurrence called vapor

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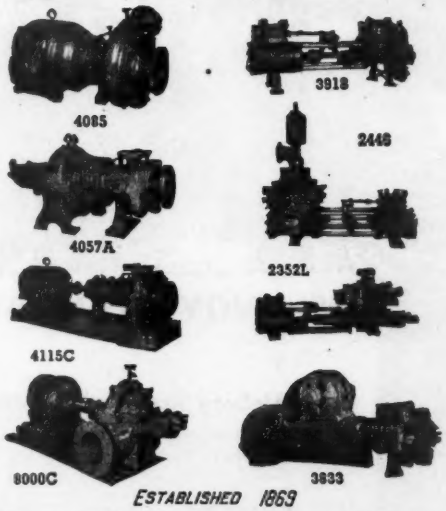

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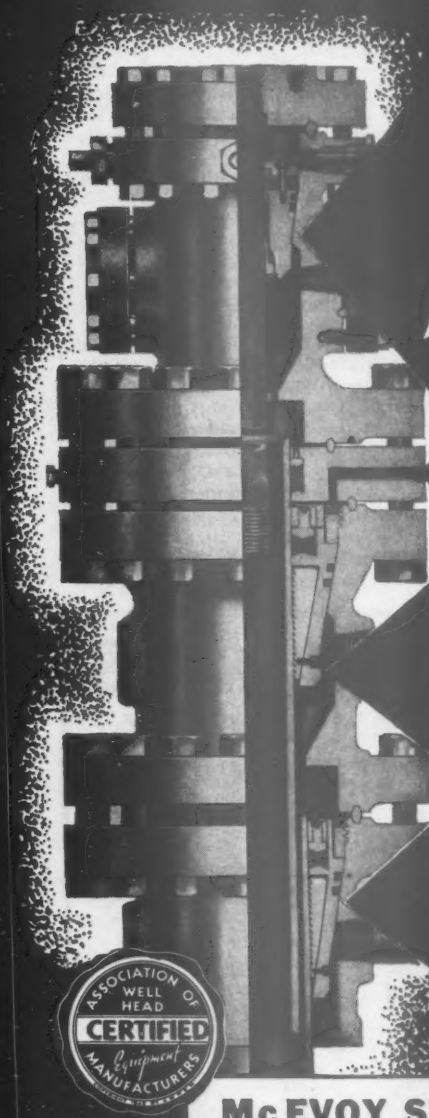

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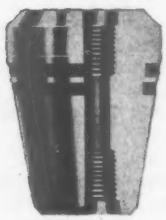

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Threaded mandrel hanger for use where completion methods do not require a specialized hanger.

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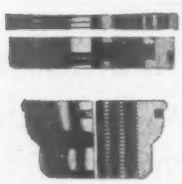

LHCS-1

Affords a non-welded seal for utmost safety. Slips may be locked together and landed through preventers if desired. This hanger is highly desirable where N-80 pipe is being set, due to difficulty of obtaining a satisfactory weld on this class of pipe.

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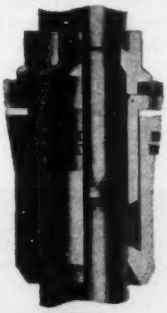
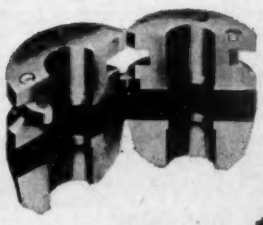


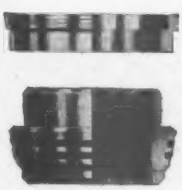
ASTM

Permits running and landing of tubing through assembled christmas tree. This hanger is designed to permit any method of well completion.



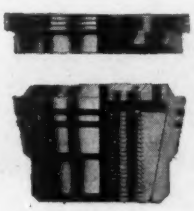
ALK

Used in completions where a polish joint hanger would otherwise be applied, this hanger eliminates the polish joint, since a seal can be effected on any joint of tubing. It can also be used as a blowout preventer.



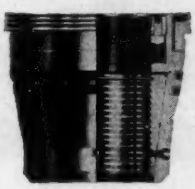
LHCH

Threaded mandrel hanger permits landing of casing through preventers and is satisfactory where close spacing of pipe is not necessary.



LHCLWS

The LHCLWS Casing Hanger utilizes slips for suspension and welded seal. Slips are assembled inside housing and complete assembly may be landed through blow-out preventers.



LHCS-2

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cross-flow would have been noted in the space between the plates at heavy liquid rates where the liquid gradient forced more than a proportionate share of vapor to rise through the lower plate on the liquid outlet side. Due to the fact that the liquid outlet or high vapor rate side of the top plate is above the liquid inlet or low vapor rate side of the lower plate, vapor cross-flow occurs from above the liquid outlet side of the lower plate to below the liquid outlet side of the upper plate.

That this must occur had been deduced from the air-and-water work and in correcting the crude pipe still plates to stop dumping, an effort had been made to reduce vapor cross-flow tendency simultaneously. As noted above, if more caps are redesigned, blanked, choked, or more widely spaced on the liquid outlet side of the plate than on the inlet side, it should be possible by proper choice of cap arrangement to obtain uniform vertical vapor flow from every section of the plate for a certain liquid flow rate and total plate vapor rate. Such an arrangement will lead to vapor cross-flow concurrent to liquid flow over the plate at liquid rates below the balance rate and vapor cross-flow counter-current to liquid flow will again take place if the liquid rate is raised substantially above the balance rate of the modified plate. Thus, it is possible to fix a plate to operate completely in balance for only one liquid and vapor rate combination. This rate is usually chosen near to the anticipated maximum, assuming that some concurrent flow of liquid and vapor across the plates while coming up on the unit or during infrequent low charge rate periods will not be harmful. Perfect balance even at high rates is usually not essential to quite excellent operation.

To return to the rerun pipe-still case, an apparently reasonably balanced plate design had been incorporated in the unit. The observation ports, however, showed that at one point in the surge cycle, a small amount of over-all vapor cross-flow existed. Whereas the crude still tower plates had been supported by beams paralleling the liquid flow across the plates, the heavy cast-iron rerun tray of a different manufacturer's design was supported by two deep "I" beams bisecting the two halves of the plate and running transverse to the liquid flow direction. Droplets of accumulated entrainment falling from these beams were soon to be diverted upstream relative to plate liquid flow by mild countercurrent vapor cross-flow at surging throughputs. The cross-sectional tower area was 133 sq. ft., but the clearance area between the beams and the liquid surface was only 12 sq. ft. (12 to 14-in. vertical clearance). Across this limited area a small amount of vapor cross-flow carried considerable entrained spray upstream on the plate where it was deposited as vapor cross-flow velocity decreased. This swelled the volume of liquid trying to cross the plate. This, in turn, both increased the gradient to cause more vapor cross-flow and decreased the under-beam clearance to aggravate upstream liquid pile-up. The vicious circle of events was repeated until, after a couple of minutes, pressure drop across the under-beam area became so great as to build up enough pressure beneath the liquid inlet side of the plate above to discharge over the top plate the dammed-up liquid thereon.

At the same time, the built-up pressure reduced the volume of incoming vapor entering the outlet liquid side of the lower plate thus forcing the vapor to purge the lower plate. With purging over, normal plate operation preceded another build-up and purge, and so on. Caps were blanked so as to eliminate countercurrent vapor cross-flow, and, to some extent, these blanks were so placed as to reduce spray height in the under-beam limiting area. This unit has now operated at above design load without surges or other tower limitations.

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The necessarily involved description of surging may be clarified by reference to Fig. 1 which illustrates diagrammatically the state of the tower just before the plants are suddenly cleared of accumulated excess liquid. Vapors from A_1 pass through the bottom plate of those shown into space C_2, but due to liquid hold-up in space A_2, they must pass over to A_2 and thence into space C_2. Construction at the plate support beam section (noted by items 1 and 2) build up sufficient pressure in spaces C_2 and C_3 to cause vapors to break through from C_2 to A_3 and from C_3 to A_4, thus clearing the plates but setting the stage for another surge as vapor cross-flow reestablishes the liquid holdup in spaces A_2, A_3, A_4, etc.

Profited from Experience

The lessons learned from the Bayway crude and rerun stills and the air-and-water studies were put to use in the design of new pipe stills for Baltimore and Baton Rouge. Improved plates were designed for these units which were otherwise duplicates of the Bayway units and intended to reduce 30,000 bbl. per stream day of Southwest Louisiana or equivalent crude to 16 per cent bottoms. It was anticipated that the plate changes incorporated in these units would permit over-design throughputs but since the war program would permit no hold-up in the construction work already under way to reduce the size of the tower and since the refineries could increase their war contribution with excess crude distillation capacity or efficiency, larger charge pumps, more furnace surface, and other limited changes were made to the units while under construction to permit taking advantage of some of the expected excess tower capacity.

Both these units have come up to expectations as may be evidenced by a few figures on the Baton Rouge unit. Within four days of first firing, the charge rate was 30,000 bbl. per stream day, and the unit has taken 50,000 bbl. per stream day of Southwest Louisiana crude to 18 per cent bottoms with adjacent cut gaps of from 10° to 15° F. better than design. The furnace limits capacity. Vapor velocities are over 200 per cent of the "critical" velocity mentioned previously.

In the course of studies involving greatly increasing alkylate producing capacity in the Jersey company refineries early in the war, a 10-ft. diameter, 50 single-pass-plate isobutane tower was tested. This tower charged some 7,500 bbl. per stream day of alkylate and butanes, producing 5,000 bbl. per stream day of 80 per cent isobutane content overhead product, about 1 per cent of the butanes left in the bottoms being isobutane. Reflux meters indicated 25,000 to 30,000 bbl. per stream day but careful heat and material balances proved that much of the pumpback was being carried over from the tower as liquid. Despite this upset condition, the tower operated smoothly and had an over-all plate efficiency as usually defined of about 80 per cent.

Important Information Gained

With the crude and rerun still findings in mind, differential pressure drop manometers were installed on each set of five adjacent plates of the tower, gage glasses were used near the tower top and bottom to indicate liquid levels in the downcomers, and, subsequently, observation ports were placed on the tower at several points. An extended study revealed the following information.

Whereas the crude stills had dumped but had not flooded, the isobutane towers was found to be badly flooded. High liquid flow rates had caused gradients across the plates which upset vapor flow and resulted in countercurrent vapor cross-flow as outlined above. In this case, however, due partly to a considerable number of transverse plate support beams, vapor cross-flow velocity was so high over much of the plate as to entrain liquid spray upstream. Unlike the rerun still, however, surging did not occur and the build-up of liquid was only limited by filled downcomers. With 27 in. of plate spacing, there was good evidence that the outlet weirs were submerged about 12 in. while the plate submergence on the liquid inlet side in the tower proper was as great as 25 in. It is remarkable that smooth operation and fair fractionation resulted under these conditions. When the tower load was reduced to eliminate flooding, a total overhead vapor load (product plus reflux) of only 20,000 bbl. per stream day was possible.

The remedies outlined above were applied to the tower plates and, in addition, downcomer to plate clearances were increased, and some caps located too close to overflow weirs removed. It was necessary to make two successive plate modifications but well before the close of the war this tower was able to handle 45,000 bbl. per stream day of vapor and liquid load with a plate efficiency of at least 106 per cent using the most conservative of careful special duplicate sample analyses. There was good reason to believe the true efficiency was more nearly 145 per cent.

In all, six Jersey company affiliate alkylation unit isobutane towers were modified with a most gratifying effect on alkylate and aviation gasoline output. It should, of course, be noted that seasonal condenser water temperature conditions and other considerations limited application of the findings and in no case has a tower limitation as such been reached. Reboiler capacity was provided by using 100 lb. steam on units designed for either high-pressure or exhaust steam, vapor and liquid lines from the reboiler to the tower being increased in size. Preheat was also increased by using live steam, supplemented by improved technique to minimize preheater fouling.

Tower Charge Hydraulics

It may be well at this point to mention the need for consideration of tower charge hydraulics. Just as an obstruction in any single-plate downcomer must result in flooding the entire tower, so upset hydraulics where charge enters a tower may lead to flooding. Cold feed, or even hot or slightly vaporized feed, particularly in a tower producing a high bottoms-to-charge ratio, may impose an excessive liquid load on the feed and lower plates and flash distrubances where such feed meets hot reflux in the tower may further

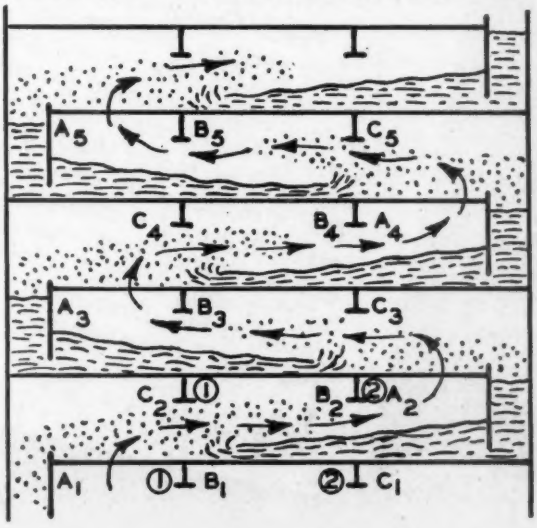

Fig. 1—Typical countercurrent vapor cross flow. Conditions shown are for countercurrent vapor cross flow typical of plate action on the Bayway rerun pipe still prior to plate revisions: arrows show direction of cross vapor flow

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upset hydraulic balances easily affected by small absolute forces. In some cases, a plate with vapor bypasses to permit introducing feed, mixing it with reflux, and allowing vapor separation may be desirable. Often over-flashing feed by preheat in excess of the theoretical optimum for fractionation may be desirable when liquid load at and below the tower feed is limiting capacity. The small loss in fractionation efficiency due to over-flashing may be more than made up by the increase in reflux possible when minimizing below-the-feed flooding tendency.

Fractionating Efficiency

Reference has been made to isobutane tower plate efficiencies. It is, perhaps, unfortunate that the generally used criterion for fractionating efficiency is the approach to point equilibrium. When the work done by a commercial plate equals that which would result from establishing equilibrium between the liquid and vapor entering that plate, it is said to be 100 per cent efficient. This expression discourages attempts to exceed a 100 per cent figure. Where liquid enters a commercial plate, however, it successively contacts a series of vapors of constant or varying composition, depending on the degree of vapor mixing between plates. Lewis[6] has shown that a plate efficiency, expressed in the usual terminology, of as much as 300 per cent may be possible on a commercial plate under certain conditions. Probable over-all average plate efficiencies in the isobutane towers discussed have reached 145 per cent and higher levels may be possible with improved tower designs. These efficiencies have been based on samples of plate liquid from several points in the tower, while spectrometric analyses and buildup of low concentration components by successive low-temperature fractionations of samples have been used to obtain reliable results.

The information outlined in this paper has been presented in various reports and through oral discussions to the Technical Advisory Committee to the Technical Committee of the Petroleum Industry War Council. Companies throughout the industry have thus had the benefits of the findings to assist them in meeting war fuel requirements. The Petroleum Administration for War has also used the work in their studies of Defense Plant Corp. units. Stimulated by the Development company data, other companies have also contributed to the widely-known T.A.C. tower study reports.

Standard Oil Development Co. plans to continue its fractionating tower studies, using the most up-to-the-minute results of its work to improve the efficiency and capacity of other existing equipment as has been done in the examples cited. Where bottlenecks other than towers limit units, these may be removed as such, or equipment may be doubled up so as to release towers here and there for new units or duties. Worthwhile economies will be possible in new unit designs when advantage is taken of the lessons learned from such studies as are outlined above. It is hoped that extension of these studies by other companies will increase the ability of the petroleum industry to offer to the nation in peace, as in war, better products at lower costs. Unequivocally, although the war is over, there is "no peace for fractiontors," taking the word to apply to pieces of equipment or to those who must design, test, and operate them. Indeed, the whole wide field of process equipment unit design demands engineering research and more engineering research.

[6]W. K. Lewis, Jr., "Rectification of Binary Mixtures," Jour. Ind. and Eng. Chemistry, 28, 399 (1936).

Period of Development

(Continued from page 108)

or

$$C = \frac{2Qy^{1.5}}{3N^{0.5}}$$

In order to derive Equation 8, we note that:

$$P_e = \int q e^{-1.7} \, dy$$

but $q = Qy/N$ so

$$P_e = \frac{Q}{N} \int y e^{-1.7} \, dy$$

which upon integrating between the limits zero and y gives Equation 8.

In order to derive Equations 9 and 10, we note that:

$$\frac{dr}{dy} = \frac{R}{N}$$

from which

$$r = Ry/N$$

but

$$q = r(1 - C) = \frac{Ry}{N}(1 - C)$$

so

$$\frac{dC}{dy} = \frac{Ry}{N}(1 - C)$$

and

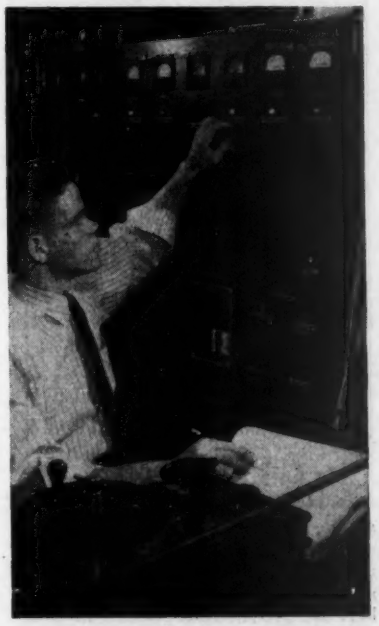
$$\int \frac{dC}{1 - C} = \frac{Ry^2}{2N}$$

which, when integrated, gives Equations 9 and 10.

Mass Spectrometer Analyzes Gases

THE mass spectrometer, one of the amazing new electronic instruments, finds important commercial utilization in accurately analyzing gases. The industrial types were developed primarily for use in the petroleum and chemical industries, and are finding ever-increasing uses.

This complex instrument is capable of doing a highly scientific job. A single man with one spectrometer can do the work of several chemists in analyzing gases as appear in the aviation-gasoline and other oil and gas projects. The answers produced are complete and accurate, and six to eight times as fast as those obtained with previous methods.



This modern mass spectrometer requires about 15 kilowatts and operates on 110 volts, 60 cycle power supply. Front view shows the operating panel. (Courtesy Westinghouse Electric Corp.)

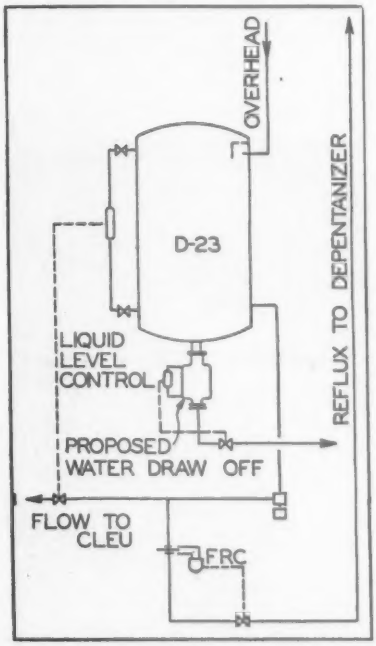
Heart of the instrument is the spectrometer tube. Gas enters the tube at the ion source, is ionized and accelerated through the tube. The electromagnet is adjusted so that only the molecules being sought will find their way to the "collection plate" where they are gathered and measured. By changing the strength of this field, different molecules can be made to pass through the exit slit. Lighter molecules impinge on the outer wall of the tube and the lighter ones strike the inner wall and both are drained to ground, leaving only those of correct weight to reach the exit slit in the tube.

XUM

PLANT PRACTICES

Water Trap at Bottom of Depentanizer Reflux Drum

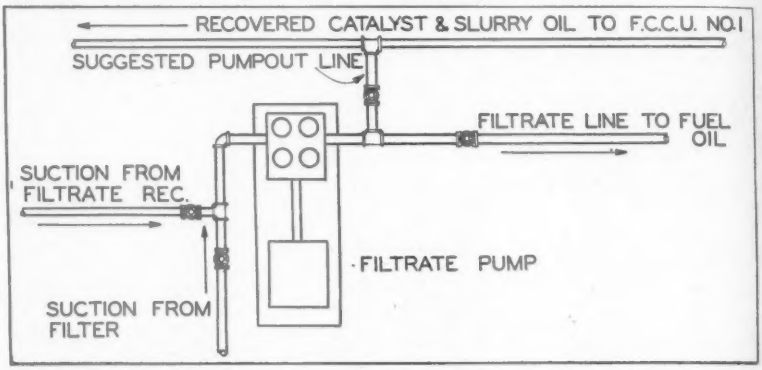
AS a water trap on the reflux drum in the depentanizer tower assembly an 8-in.-diameter section is attached to the 2-in. flange on the bottom of the drum. It is equipped with



a liquid-level control arrangement with a 1-in. outlet line and control valve which maintains a predetermined level in this auxiliary chamber. In this manner water is practically eliminated from the reflux drum and thus from the reflux stream returning to the unit. (Idea submitted by E. S. Ceruti, instrument department.)

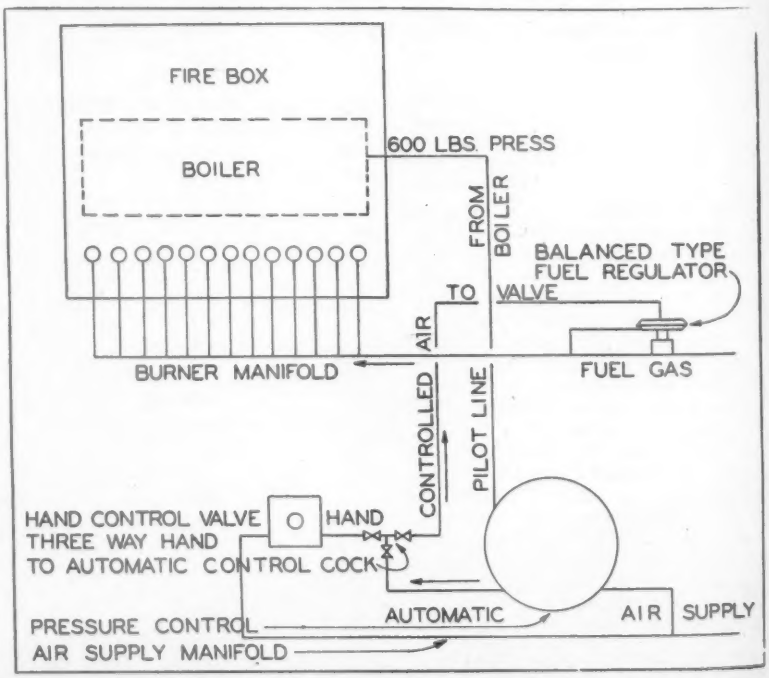
Emergency Pump-Out System

NUMEROUS accidents or stoppages may wreak-havoc or cause trouble in a complicated catalytic cracking unit. In case the vacuum pump of Fluid Catalytic unit should stop, serious difficulties might result. To avoid most or all of this danger, an auxiliary pump-out line is installed from the discharge line from the filtrate pump which takes suction on the filtrate receiver from the slurry filter; this line leads to the reslurry catalyst which is returning slurry to the cracking unit. In case of vacuum pump failure, estimated to average about one instance per year, heating oil from the cracking unit could be sent directly into the filter case; suction could be taken on the filter case to discharge back into the return line to the catalyst unit. This system will save freezing of the filter drum by catalyst settling out in the filter, and by washing out the cleaning charge line, the filter case and the return line a chance is given to save the rotating drum and the precoat on the filter drum. Idea submitted by E. G. Case).


RECOVERED CATALYST & SLURRY OIL TO F.C.C.U. NO.1
SUGGESTED PUMPOUT LINE
FILTRATE LINE TO FUEL OIL
SUCTION FROM FILTRATE REC.
FILTRATE PUMP
SUCTION FROM FILTER

Control of Heating Rate

THIS idea prevents the frequent fluctuations of steam pressure and "popping" of steam safety valves because of the varying heating value of the fuel gas to the boiler burners. Unavoidable variation of heating value due to intermittent and unforseeable additions of high B.t.u. content gases from the vapor-recovery units. Popping of the safety valves not only wastes fuel and steam, but it induces carryover of liquid water into the superheaters. Deposits cannot be removed from these superheaters; therefore the deposits must be prevented if at all possible. The device is simple and consists in incorporating a control mechanism in the steam-pressure recorder in such manner that the steam pressure controls the fuel-gas pressure to the burners. In this manner excessive heating is prevented with its excess steam generation and its possible cause of replacement of the superheater tubes each of which costs up to $500 in material and labor to replace. (Idea submitted by W. R. Kehoe, instrument repairman).



(The ideas described here are used in the Baytown, Tex., refinery of Humble Oil & Refining Co.)

Bottle-Washing Unit Designed For Laboratory Sample Bottles

A RAPID and efficient method of washing sample bottles for reuse was developed in the laboratory and built by the maintenance department of the Marcus Hook, Pa., refinery of Sinclair Refining Co. Before this washer was installed, all bottles were washed by hand, and about 300 was a man's daily average. This number was not sufficient to meet the requirements of the refinery, and it was necessary to use new bottles when washed ones were not available.

A one-quarter scale model of the equipment was constructed, using cardboard and balsa wood. This was given to the maintenance department which built several units. One man can operate two machines, and wash about 48 bottles in 12 minutes, which meets all plant requirements. The method eliminates the use of any strong chemicals and consequently any hazards from their use.

The washing machines, operated in pairs, consist of a square metal tank about 18 in. high and large enough to hold four rows of 12 pint bottles. The bottles are placed neck down over jets near the bottom of the tank. The washing solution is made up in a tank of about 50-gal. capacity. Soap and cleaning compound are used in the cleaning water. A rotary pump is connected between the tank and each machine, with the suction arranged to circulate the cleaning liquid in the machine through the jets and at the same time pump from the tank through the jets. It is also arranged to pump from the machine to the storage tank. Relative positions of the pump, tank and washer vary with each installation. The schematic piping hookup shown in Fig. 1 may be arranged, to serve the washer, as desired.

Manifolded to Jets

Air, water, and steam are manifolded to the jets also. The steam enters the water line through an ejector. It was found that when sufficient air is blown through the soap solution in the washer the suds overflow, and carry off the oil removed from the bottles thus keeping the solution oil free.

Additional equipment consists of two racks for draining bottles, one enclosed in a steam chest for bottles used for heavy oil, and one open for bottles used for light oils. A third machine is used for bottles that might require kerosene rinsing before the regular soap and water wash. This is smaller than the others.

After the bottles have been drained on the racks, the operator places 48 of them neck down in trays designed so that when lowered into the washer each of the bottles sets over a jet. The solution is then pumped through the jets, and at the same time a small amount of air is introduced into the line on the discharge side of the pump. The air tends to atomize and to increase the velocity of the solution. While this operation proceeds the operator washes the outside of the bottles with a hand brush. The pump is then stopped, and sufficient air is blown through the jets to fill the machine with foam.

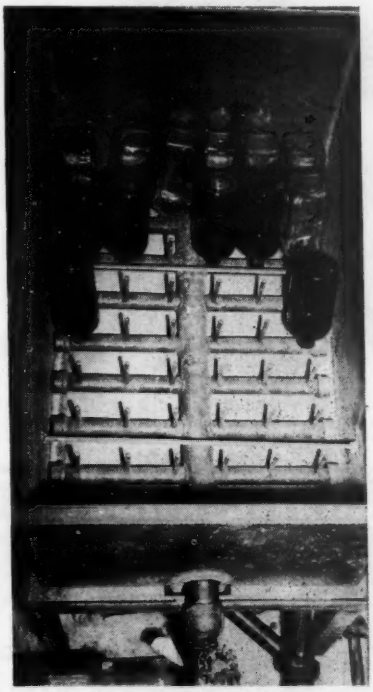
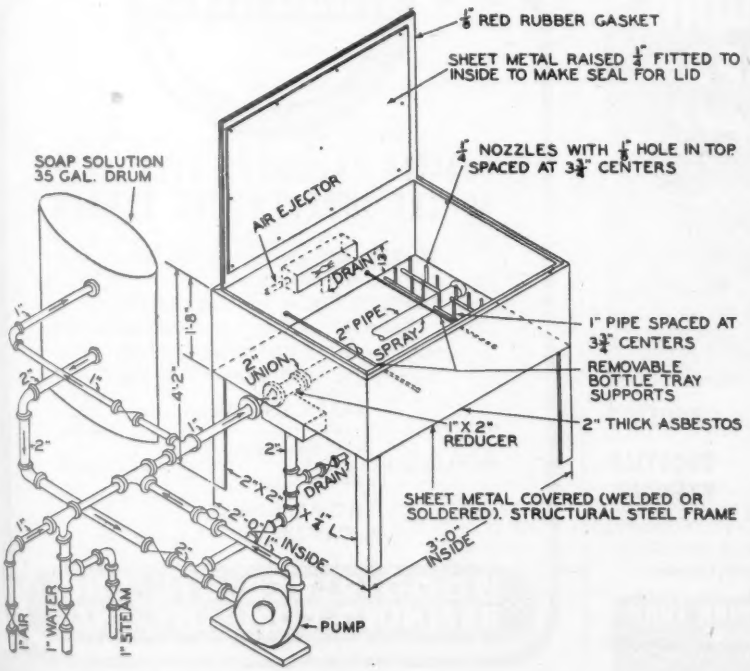
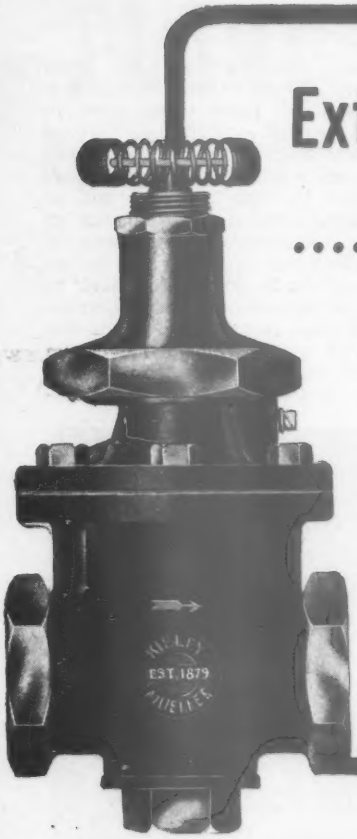


Fig. 2—Inside view of bottle-washing machine

A drain, slightly lower than the sides of the washer, is then used to float off the oil that has floated to the top of the foam. The solution is then pumped from the machine to the storage tank, and hot water made by means of the ejector is run through the jets to rinse the insides of the bottles. At the same time the outside of the bottles is rinsed with a hose. The top of the machine is then dropped and steam introduced to heat the bottles as an aid to drying. Hot air, produced by passing compressed air through a coiled heater, is then run through the jets to dry the inside of the bottles. The tray of clean bottles is then removed from the machine. A complete cycle requires about 12 minutes.

Fig. 1—Isometric view of bottle-washing machine





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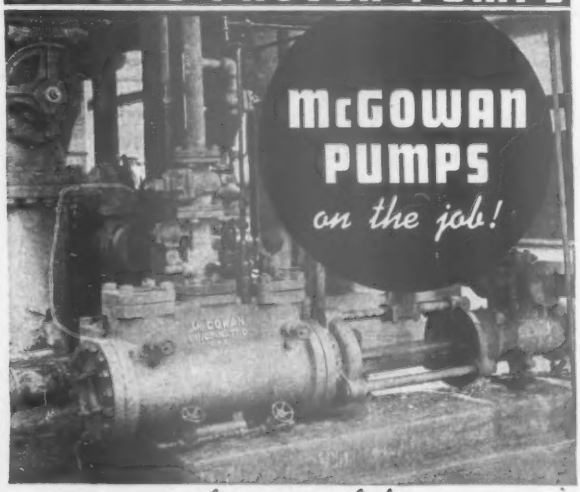

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WOOD RIVER OIL AND REFINING COMPANY, INC.

The Refiner's Notebook

A WEEKLY FEATURE OF THE OIL AND GAS JOURNAL

Topping-Plant Economy

THE most important or most economical exchanger in a crude-oil exchanger system is the bottoms or topped crude exchanger (1 in Fig. 1). Of course, if the topped crude oil is to be charged hot to some other process such as cracking or vacuum distillation, its heat should not be removed and the next best exchanger is the gasoline condenser (2 in Fig. 1) exchanger. There is not much choice between the other exchangers (3, 4, 5, and 6 in Fig. 1 for naphtha, kerosene, distillate, and gas oil) except that in a general way the exchanger that handles the most material or the exchanger that handles the highest temperature stock, is the best.

In most situations the relative suitability of a stock for heat exchange may be judged by multiplying its temperature by the percentage of it in the crude oil, except that in such a comparison the value that is obtained for a condenser exchanger should be multiplied by about 2. Thus, for a common breakup of crude oil:

	%	°F.	Index
Topped crude	45 ×	600 =	27,000
Gaso. condenser	2 × 20 ×	300 =	12,000
Gas oil	10 ×	500 =	5,000
Kerosene exchanger	10 ×	400 =	4,000
Naphtha exchanger	10 ×	350 =	3,500
Dist. exchanger	5 ×	450 =	2,250

The amount of heat that should be picked up in each exchanger will be discussed in The Refiner's Notebook No. 71 of December 8, under the title of "Economics of Approach."

Fig. 1 illustrates the general flow of crude oil in a simple topping unit. The general situation is not altered if several rather than one fractionating tower is used. The crude oil should come in contact with the products in the same order, that is, gasoline, naphtha, kerosene, distillate, gas oil, and finally topped crude oil.

Economy of Topping Units

Figs. 2, 3 and 4 indicate the economy of topping plants operating at 400°, 600°, and 500° F. respectively. These figures may be used to estimate the general behavior of the exchanger and pipe-still system by which crude oil is heated in a topping plant. The figures are based on the following formula which

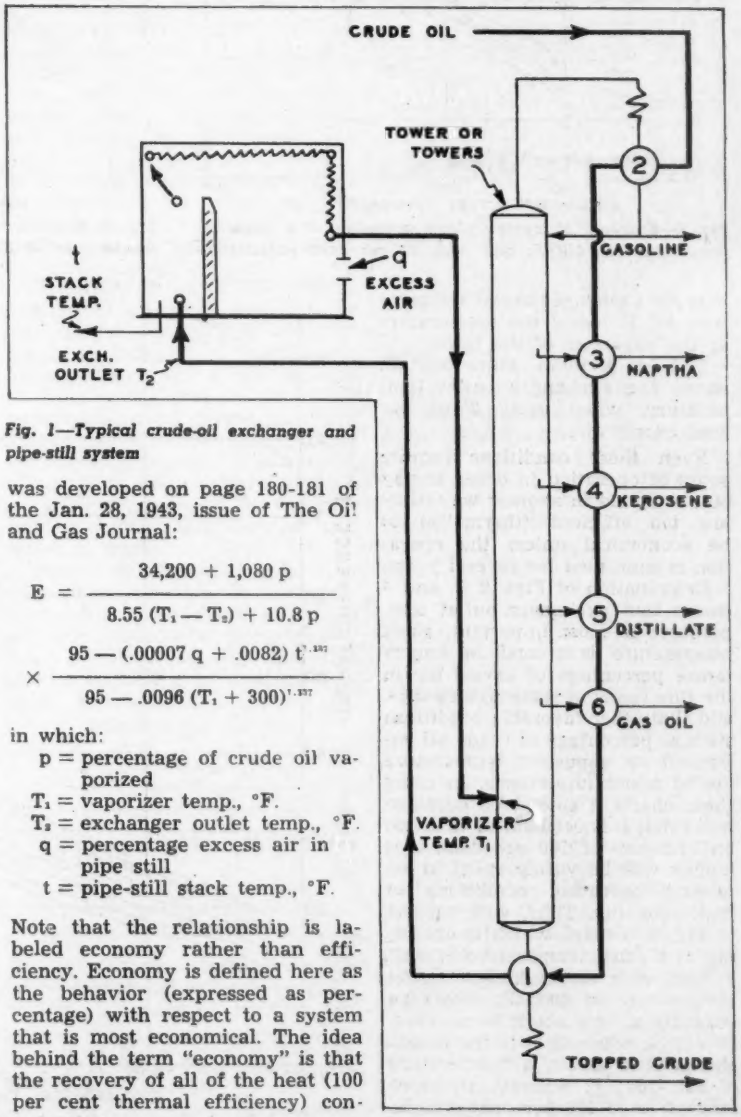

Fig. 1—Typical crude-oil exchanger and pipe-still system

was developed on page 180-181 of the Jan. 28, 1943, issue of The Oil and Gas Journal:

$$E = \frac{34{,}200 + 1{,}080\,p}{8.55\,(T_1 - T_2) + 10.8\,p} \times \frac{95 - (.00007\,q + .0082)\,t^{1.337}}{95 - .0096\,(T_1 + 300)^{1.337}}$$

in which:

p = percentage of crude oil vaporized
T_1 = vaporizer temp., °F.
T_2 = exchanger outlet temp., °F.
q = percentage excess air in pipe still
t = pipe-still stack temp., °F.

Note that the relationship is labeled economy rather than efficiency. Economy is defined here as the behavior (expressed as percentage) with respect to a system that is most economical. The idea behind the term "economy" is that the recovery of all of the heat (100 per cent thermal efficiency) contained in the products is a highly uneconomical condition because of the enormous cost of the exchangers and pipe still required in recovering all of the heat. The most economical conditions of operation are approximately:

No. 69 in a series by W. L. Nelson, professor of petroleum refinery engineering, University of Tulsa

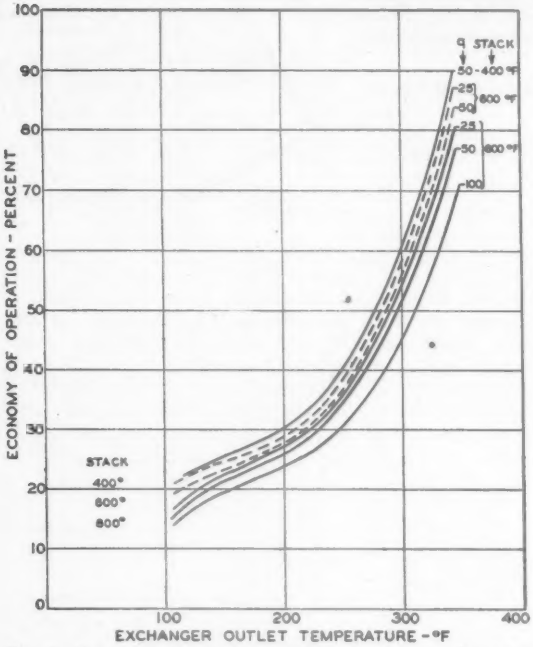

Fig. 2—Economy of topping plants operating at a vaporizer temperature of 400° F. and with 20 per cent vaporization

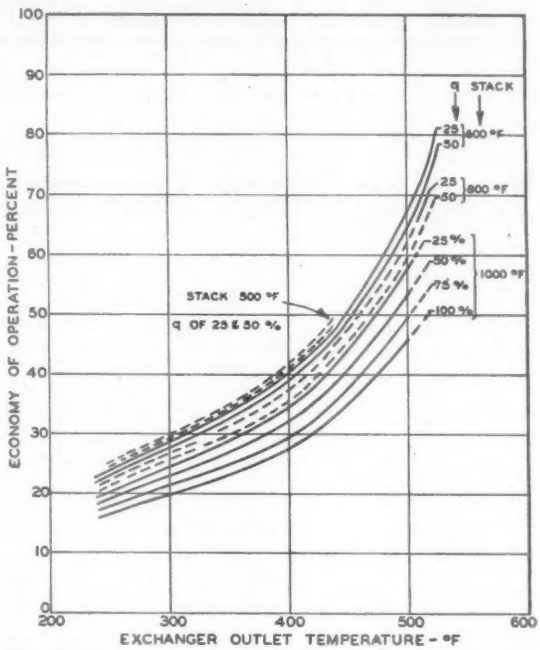

Fig. 3—Economy of topping plants operating at a vaporizer temperature of 600° F. and with 40 per cent vaporization

1. An exchanger outlet temperature 40° F. below the temperature at the vaporizer of the tower.

2. A stack temperature 300° F. above the exchanger outlet temperature, when using 25-50 per cent excess air.

Even these conditions require years of operation in order to pay out, or stated in another way, they are too efficient (thermally) to be economical unless the operation is continued for several years.

Examination of Figs. 2, 3, and 4 shows that exchanger outlet temperature is most important, stack temperature is second in importance, percentage of excess air in the flue gas is of some significance, and that other favorable conditions such as percentage of crude oil vaporized or vaporizer temperature are of minor importance. In using these charts it should be borne in mind that it is economical to attain an economy of 100 per cent, that money will be wisely spent in attaining operating conditions of high economy. Thus, with respect to Fig. 3, a plant which is operating at a stack temperature of 800° F. and with an exchanger outlet temperature of 400° F. shows an economy of only about 36 per cent. It will be economical to install exchangers to attain a temperature of 525°-560° F. whereat an economy of 75 to 100 per cent will be attained.

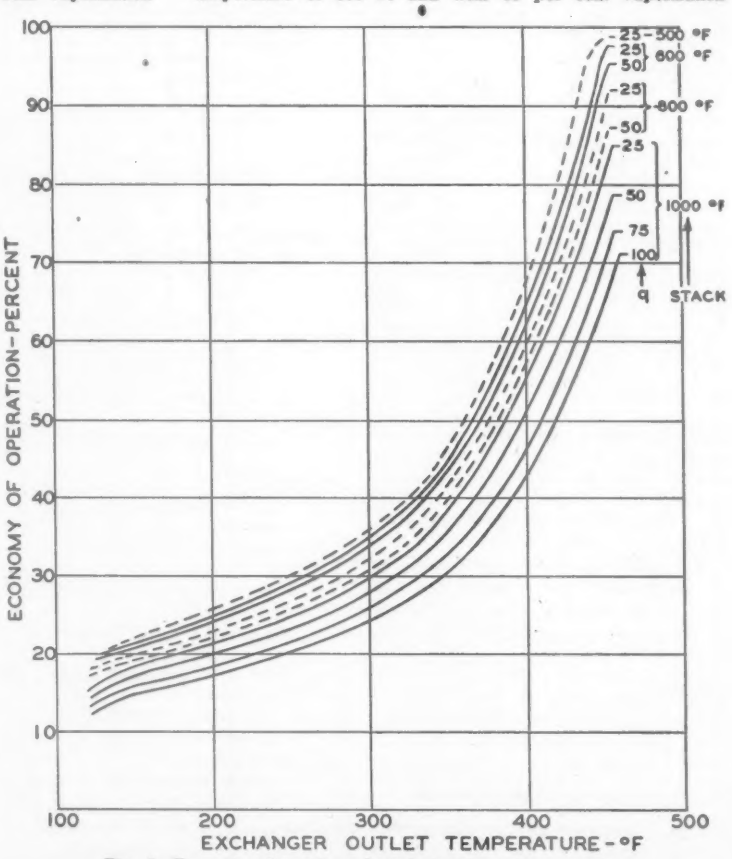

Fig. 4—Economy of topping plants operating at a vaporizer temperature of 500° F. and with 30 per cent vaporization

Preparation and Testing of Concrete

CORRECT proportioning and mixing of ingredients to produce good concrete and effective testing of slurry and finished concrete are fundamental features of oil-field engineering work. Durable concrete installations depend upon the correct proportions of cement, coarse and fine aggregate, and water, and thoroughly mixing these ingredients. Crushed rock or gravel, in most cases, is used for coarse aggregate, and coarse sand is used for the fine aggregate. The Portland Cement Association recommends for southwestern United States 7½ gal. of water per sack of cement. This approximate 7 to 1 ratio will give a strength of 2 800 lb. per sq. ft. in 20 days' setting time. The cement and water are mixed with sand and gravel in such proportion that the sand will fill properly the void spaces in the coarse gravel or crushed rock. The proportion of sand to use, therefore, depends upon the size of the coarse aggregate, as follows:

Ratio of Sand to Gravel in Concrete Slurry

Maximum size of gravel in inches	Ratio of sand to total amount of gravel used, by volume	
	Minimum	Maximum
⅜	0.55	0.70
¾	0.40	0.60
1	0.30	0.50

The minimum proportions apply to well-rounded gravel, the maximum to angular crushed rock. Many engineers specify gravel screened between ⅜ and 1-in. screens, and the sand screened between 0.0058 and 0.158 sizes of screens* and use approximately two parts of sand and three parts of gravel.

Total amount of sand and gravel to use per sack of cement depends upon the consistency of the slurry required. The more gravel and sand used, the stiffer will be the slurry and the less the cost of the cement; but the harder it will be to pour the slurry uniformly and the more likely it will be that the concrete will be honeycombed with holes and cavities. Concrete mixtures are best proportioned by trial. This is accomplished by mixing the trial proportions in a box or wheel barrow and applying the "trowel" and "slump" tests.

Trowel test. — The trowel test consists of smoothing the surface of a batch of the slurry with a trowel. There should always be enough sand to permit the operator to trowel the mass to a smooth finish.

Slump test. — The amount of slump is measured by pouring slurry into a small conical form, 1 ft. in height, removing the form, and noting the number of inches that the cone slumps. For massive sections, pavements, and floors laid on the ground, the Portland Cement Association recommends that the minimum slump should be 1 in. and the maximum not over 4 in. Therefore, according to the above trial the correct ratio of ingredients is: cement, 1 part; sand, 2½ parts; gravel, 3¾ parts.

Proportion of water.—Most sand and gravel used on a job contains more or less water. This water in the sand becomes a part of the mixing water and hence amount of water in the sand should be determined and subtracted from the amount of water added to form the correct proportion. The amount of water is easily determined by weighing a sample of the wet material, drying the sample and weighing again.

Method of calculating volume of ingredients needed.—It is necessary to know the amount of cement and the amount of sand and gravel needed for any concrete job. This can be calculated by a simple formula† as follows:

$$\text{Absolute volume} = \frac{\text{unit weight}}{\text{apparent sp. gr.} \times \text{unit wt. of water}}$$

Unit wt. of water: 62.5 lb. per cu. ft.

Apparent sp. gr. of sand: 2.65

Apparent sp. gr. of gravel: 2.65

Apparent sp. gr. of cement: 3.1

Suppose the concrete batch consists of one sack of cement weighing 94.1 lb., 2.2 cu. ft. of dry fine sand weighing 111 lb. per cu. ft., 3.6 cu. ft. of dry coarse aggregate weighing 100 lb. per cubic foot. This mixture is to be mixed with water until the batch has a ratio of 7 gal. per sack. The apparent specific gravity of the cement is 3.1 and of the sand and gravel, 2.65. The volume may be calculated as follows:

Examples of Proportions of Ingredients to Use in Trial Mixtures for Concrete Where Water Cement Ratio Is 7½ Gal. of Water per Sack Cement

Cement	Sand	Gravel	Amount of slump (in.)	Trowel test
1	3	4	½-1	Rough
1	2½	3¾	3-4	Fairly smooth
1	2¼	3½	5-7	Quite smooth

$$\text{Cement, 1 cu. ft.} \times \frac{94.1}{3.1 \times 62.5} = 0.49 \text{ cu. ft.}$$

$$\text{Sand, 2.2 cu. ft.} \times \frac{110}{2.65 \times 62.5} = 1.46 \text{ cu. ft.}$$

$$\text{Gravel, 3.6 cu. ft.} \times \frac{100}{2.65 \times 62.5} = 2.18 \text{ cu. ft.}$$

$$\text{Volume of water} \ldots \frac{7 \text{ gal.}}{7.5} = 0.93 \text{ cu. ft.}$$

Total volume of concrete .... 5.06 cu. ft.

The cement required for 1 cu. yd. of concrete is, therefore, 27/5.06 or 5.34 sacks, or 1.33 bbl. The quantities of sand and gravel may be found by taking the number of cubic feet used with each sack of cement as follows:

$$\text{Sand} \ldots\ldots \frac{5.34 \times 2.2}{27} = 0.43 \text{ cu. yd.}$$

$$\text{Gravel} \ldots\ldots \frac{5.34 \times 3.6}{27} = 0.71 \text{ cu. yd.}$$

The average value of 2.65 for the specific gravity is sufficiently accurate for sand and gravel and common varieties of crushed rock.

It is important in the selection of the sand and gravel that only clean material be used. Dirty clay covered gravel or muddy sand may lead to failure even with proper water control. The quality, size, and grading of the sand and gravel are important both from the standpoint of effectiveness of the concrete, and economy. Because size and quality affect the workability of the concrete for foundations, most specifications limit the maximum size of the coarse aggregate to 1 in.

*The State Highway Department of Texas recommends that not more than 5 per cent of the sand should be larger than ¼ in. in size, not more than 50 per cent should be larger than 0.0238, and none should be smaller than 0.0058.

†For method of determining specific gravity, see Design and Control of Concrete Mixtures, Portland Cement Assn. Circular, pp. 1-23, 1931.

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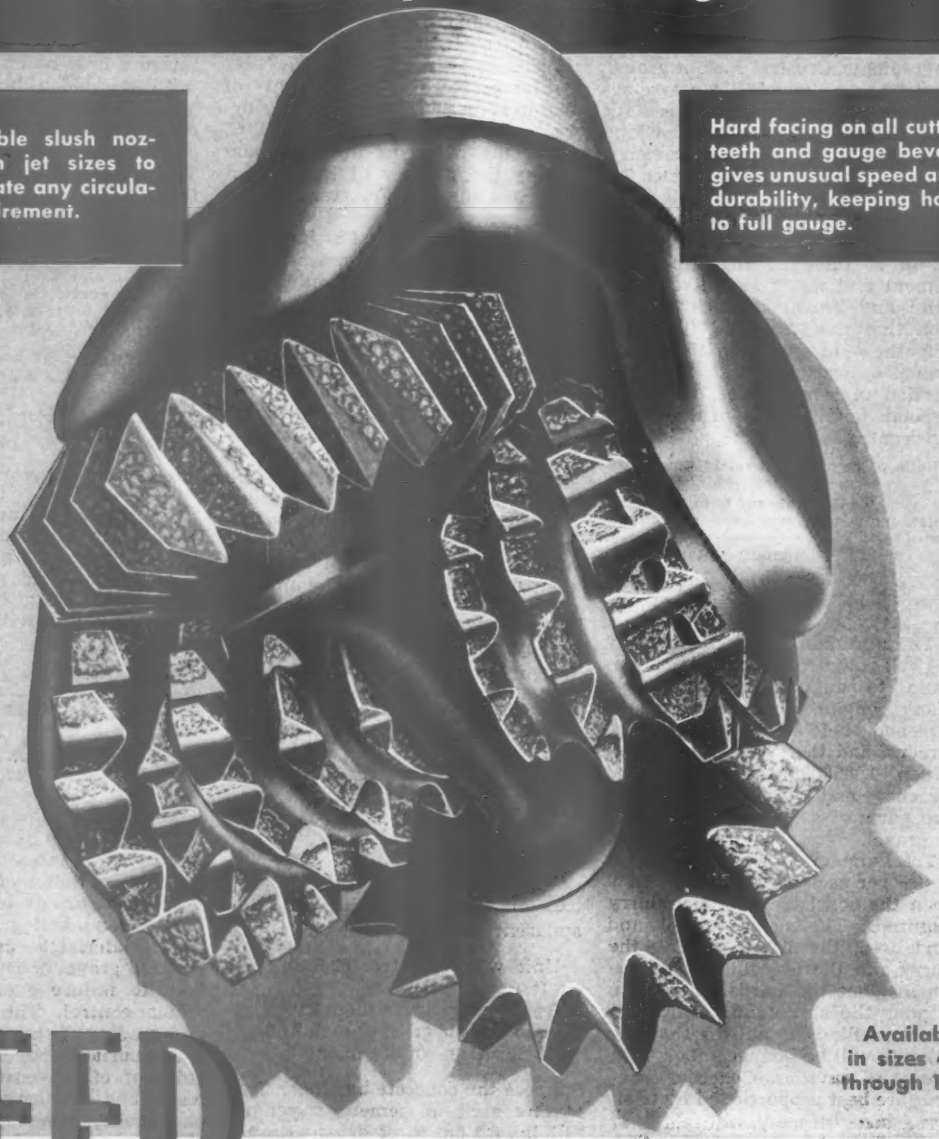

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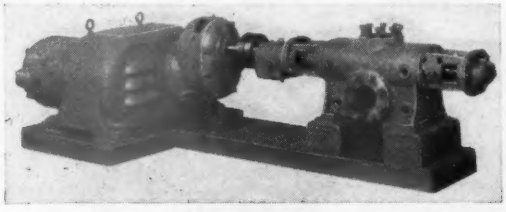

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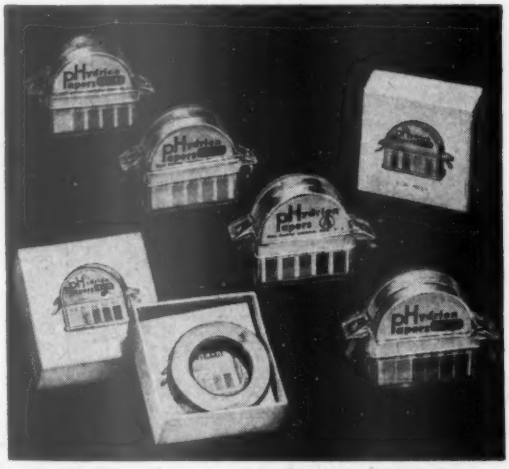

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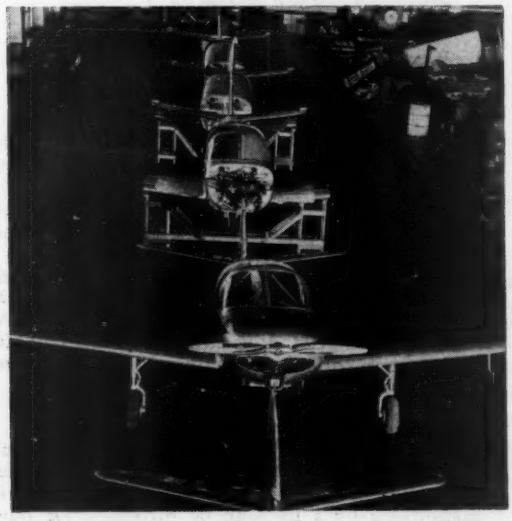
(3) FLY THE SWIFT. This is the announcement for this new all-metal personal airplane, manufactured entirely on production tooling: "Mount either catwalk and unlock the sliding enclosure (same key fits the ignition). Turn on the gas by pushing a button. Pull a button to start. Both



are on the instrument panel. There are no controls on the floor whatsoever. Turn on the master switch. Taxi out, with the "control tower" cabin enclosure affording 360° ground vision. Set the elevator trim tab indicator overhead on "zero," speed up the engine. Move flap switch to "take off," turn into the wind and you're off. Set the engine at about 2,300 and cruise along at a steady 130 m.p.h. When approaching for a landing, flip

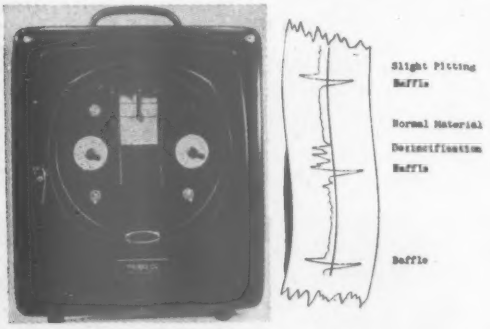
The Oil and Gas Equipment Digest presents a review of what is new in equipment and trade literature . . . makes it possible for readers to obtain full information on every subject by use of convenient "Check It—Mail It" service card. This periodic feature of The Oil and Gas Journal will include all that is new in equipment . . . at a time when new products are being introduced, and existing products improved.

Keep Informed. Save Time. Tear Out Card. Check It. Mail It.

the control handles to "Wheels Down" and "Flaps Down." Indicator lights blink as a check-reminder. Flare out close to the ground, reduce engine speed, and in an instant the Swift has landed itself, at only 42 m.p.h. Step on the brakes and stop." *Globe Aircraft Corp.*

IT'S NEW CHECK IT

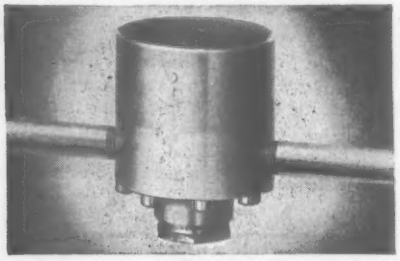
(4) NEW "SHELL" PROBOLOG is an inspection device for examining nonmagnetic tubing, without removing tubes from the equipment in which they are installed. It locates, quickly and accurately, all faulty, inaccessible tubes in heat exchangers, condensers and similar tubular equipment, and obtains a graphic record of the de-



fects as well. How it works: The probe is pushed or pulled through a tube by a cable. As it moves through the tube, the recorder flashes the position of, and charts, each defect present. Probolog detects dezincification, eroded and corroded pits, cracks, strained areas, increases or decreases in wall thickness, changes in chemical composition—a complete record in black and white. Dismantling and reassembling is eliminated. Saves time and material. Illustrated is graph of defective tube in condenser bundle. *Shell Development Co., Inc.*

IT'S NEW CHECK IT

(5) NEW GROVE MITY-MITE regulator handles initial pressures to 3,500 psi., with adjustable control range down to 5 to 1,500 psi. Weighs 2 lb., measures 3 by 3 in. Can be furnished for liquid



service. Has stainless-steel parts and body of duraluminum. Engineered for positive dead-end shutoff. Instantaneous in operation. *Grove Regulator Co.*

IT'S NEW CHECK IT

(6) NEW LANDING NIPPLE makes standard foundation for subsurface controls when a well is tubed. Provides definitely located seat for the type J removable pack-off and locking assembly which, in turn, makes the installation of other subsurface tools simple and practical. The type J flow coupling is an integral component of the landing nipple. Shoulder of the new J nipple itself provides a "metal to metal" contact—supplanting slip teeth and friction holds. These three tools, the flow coupling and the landing nipple, included in the tubing string of flowing wells, plus the removable pack-off and locking assembly, offer field engineers and operators a solution to expected — and unexpected — subsurface problems. *Otis Pressure Control, Inc.*

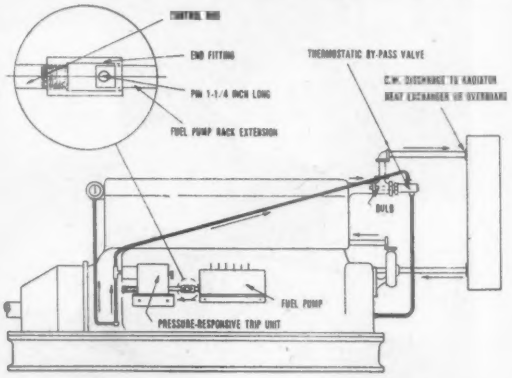
IT'S NEW CHECK IT

(7) NEW K-2 ROCK BIT has long teeth for faster drilling through sticky shale and sandy shale. Embodies an improved bearing design for longer

life. The cross-section cutters have long, widely-spaced teeth, hard-faced with tungsten carbide before hardening. Tooth design provides good chipping and slicing action. *H. C. Smith Oil Tool Co.*

IT'S NEW CHECK IT

(8) SAFETY CONTROL OF DIESELS is insured by new system against excessive operating temperatures and insufficient lubricating oil pressures.



Uses a pressure-responsive unit connected in the lubricating system and a thermostatic by-pass valve. Requires no electrical power or additional accessories. *Viking Instruments, Inc.*

IT'S NEW CHECK IT

(9) PIB LIQUID INSULATION is a war-tested product widely used as a water-proofing agent on ignition systems and to prevent corrosion and current leakage. Applied with either brush or spray, the liquid penetrates, is highly resistant

to acids, oils and greases as well as water. After an ignition system and battery has been treated with PiB, the engine will start immediately regardless of water drenching. Electric motors, treated with PiB, have run underwater continuously for 2 years. *U. S. Industrial Chemicals, Inc.*

IT'S NEW CHECK IT

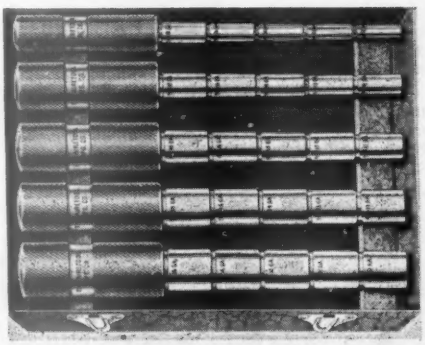
(10) NEW POUR POINT DEPRESSANT Acryloid 150 not only lowers the pour point of many oils effectively, but the reduced pour point is retained under cyclic temperature changes. Paraffin-base motor oils in the S.A.E.-10 and 20 range which show a pronounced tendency to revert to their original pour points with some additives, are effectively stabilized. Stable pour points as much as 40° or 50° F. below the original pour point are readily obtained. Is also efficient as a viscosity index improver, making it possible to raise the

	Oil	Oil + 1.25% Acryloid 150
Viscosity SUS at 100° F.	152	172
at 210° F.	44	47
Viscosity Index	114	130
Stable pour point, °F.	+20	—25
Flash point, °F.	420	420
Neut. No	0.08	0.08
Conradson carbon	0.12	0.12

viscosity index appreciably and at the same time effectively lower the pour points with the addition of one material. The refiner may, therefore, cross-brand his oils, producing an oil which will meet both S.A.E. 10-W and S.A.E.-20 specifications. Has been extensively evaluated in various laboratory tests, in single-cylinder engine tests, in the standard 36-hour Chevrolet oxidation and bearing corrosion tests and in fleet operations. Table shows results obtained with a representative oil. *Rohm & Haas Co.*

IT'S NEW CHECK IT

(11) NEW HEAT EXCHANGER tube-plug gages speed up checking. In kits of five graduated gages



from ½ in.-12 ga. to 1 in.-16 ga. Each unit has five steps of gage. Saves time. *Airetool Manufacturing Co.*

IT'S NEW CHECK IT

TRADE LITERATURE

(12) OIL FIELD WINCHES. A catalog on winches for all oil field purposes, stationary or truck mounted. Well illustrated with photographs and drawings. Specifications, weights, applications, and installation details included. *Braden Winch Co.*

OIL AND GAS EQUIPMENT Digest — IT'S NEW CHECK IT

(13) THE MODERN WAY TO AVOID BOILER TROUBLES. Title of bulletin describing all-colloidal water treatment for industrial uses. *American K. A. T. Corp.*

IT'S NEW CHECK IT

(14) EXTRACTION STEAM HEATERS. Informative bulletin on extraction steam heaters. Describes and illustrates heaters of both horizontal and vertical types for high, medium, and low pressures. Numerous cross-section diagrams explain operation as well as construction. *The Griscom-Russell Co.*

IT'S NEW CHECK IT

(15) PARALLEL FLOW BAROMETRIC CONDENSERS. Well-illustrated four-page file-size bulletin offers useful data on use of parallel flow-type barometric condensers as intercondensers and aftercondensers in connection with steam jet ejectors. Contains engineering data and selection tables. *Ross Heater & Mfg. Co., Inc.*

IT'S NEW CHECK IT

(16) FUNCTIONAL SPRING HANGERS AND VIBRATION ELIMINATORS. New beautifully printed 36-page booklet discusses design of piping layouts for flexibility. Gives many details concerning standard and special types and sizes of functional spring hangers and vibration eliminators, instructions for installation and engineering data. *Blaw-Knox Co.*

IT'S NEW CHECK IT

(17) HEAT-EXCHANGER PRICING METHOD. A new booklet has just been issued and is now available on this subject. *Foster Wheeler Corp.*

IT'S NEW CHECK IT

(18) STEEL BOILERS. Twenty-two-page catalog illustrates in color and gives full description of high-pressure firebox boilers. Specifications listed and also has cutaway views in color showing characteristics and operation. *Kewanee Boiler Corp.*

IT'S NEW CHECK IT

(19) THE KELLOGGRAM. A special issue discusses five major benefits to petroleum refiners which are seen as early outcome of atomic bomb project. Describes a wide range of industrial applications of U-235 techniques. Lists specific improvements on horizon in petroleum field: improved pumping, new-type heat exchangers, improved analytical and automatic control, possible new method for gasoline fractionation. *The M. W. Kellogg Co.*

IT'S NEW CHECK IT

(20) STAINLESS STEELS. Eight-page bulletin describes line of stainless steels, lists each type and discusses each one. Also contains tables giving

XUM

physical properties and mechanical characteristics. Has tables on stainless steel standards and applications. *Jessop Steel Co.*

IT'S NEW ✓ CHECK IT

(21) SELECTION OF INDUSTRIAL PACKINGS. New pocket-size folder serves as handy guide for selecting the most suitable packing for specific fluids, equipment and types of service. Has condensed description of each type of packing, gives leading features and purposes. Center pages are arranged to give application chart of line of packings described. *Greene, Tweed & Co.*

IT'S NEW ✓ CHECK IT

(22) AIR-COOLED HEAT EXCHANGERS. Four-page illustrated bulletin describes heat exchangers for cooling or condensing applications. Tells how it performs, has table giving tabulation of sizes, dimensions and capacities. *American Locomotive Co.-Alco Products Division.*

IT'S NEW ✓ CHECK IT

(23) HARD-FACED ALLOYS. Twenty-page booklet describes a line of hard-facing alloys, their uses, general composition, physical properties, sizes, styles, areas covered per pound, tested applications. *Stoody Co.*

IT'S NEW ✓ CHECK IT

(24) FLEXIBLE METAL HOSE FOR TANK CARS. New eight-page bulletin illustrates and suggests many practical uses for flexible all-metal hose in handling tank-car shipments of liquids and gases. Not technical, bulletin gives helpful ideas and basic information for the proper application of flexible hose to supply lines, loading problems and supplementary steam connections. *Pennsylvania Flexible Metallic Tubing Co.*

IT'S NEW ✓ CHECK IT

(25) PIPE JOINING AND REPAIRS FOR THE OIL FIELDS. Thirty-six page catalog illustrates and describes in detail easy, safe, and speedy solutions to problems of pipe joining and repairs in oil industry. Printed in two colors; contains a wealth of very helpful information. *Dresser Manufacturing Division.*

IT'S NEW ✓ CHECK IT

(26) CORROSION RESISTANT MASONRY. Fifty-page, spiral-bound material and construction manual giving helpful facts and suggestions pertaining to materials and construction methods for tanks, towers, sumps, floors, and other masonry construction. Highly-illustrated and contains much useful information. *The U. S. Stoneware Co.*

IT'S NEW ✓ CHECK IT

H. W. BOOTH *E. U. LASSEN* *H. Z. HIGHT*

MEN IN THE NEWS

Howard W. Booth has been appointed manager of sales, Wilson-Snyder Manufacturing Division of Oil Well Supply Co., Braddock, Pa.

Cutler-Hammer, Inc., Milwaukee, Wis., announce appointment of **E. U. Lassen** as assistant chief engineer. The appointment was made by **P. B. Harwood**, vice president in charge of engineering.

Appointment of **Hanford Z. Hight** as sales manager of Dresser Manufacturing Division, Bradford, Pa., is announced by **Hector P. Boncher**, general manager. Prior to his service with the Armed Forces, Hight was district manager of Dresser Manufacturing Division in the midwest territory.

Lt. Col. H. P. Valentine has been appointed manager of Mack dealer sales and operations, according to **A. C. Fetzer**, vice president of Mack-International Motor Truck Corp.

Harry B. Cookston announces the organization of his own company, the Harry B. Cookston Co. in Houston, which is agent for Weatherford Spring Co., Weatherford, Tex.; Precision Inspection Service, P. & T. Automatic Flow Valve, and General Manufacturing Co., all of Houston.

Lt. James M. Cleary, son-in-law of **Carl J. Hochenauer**, president of Texoma Supply Co., has resumed his position in the sales department of the company at Tulsa, following his return from the Navy.

Thomas J. Hilliard, vice president in charge of sales of Carnegie-Illinois Steel Corp., has announced the appointment of **Marcus M. Chapman** as manager of sales, sheet division. He succeeds **Howard V. Clark**, who recently resigned from this U. S. Steel subsidiary.

H. C. Smith Oil Tool Co., Compton, Calif., announces the opening of a branch office in Casper, Wyo., 328 South David Street. **Jack Bush** has been appointed branch manager of the new office.

John B. Mensing, assistant treasurer of The National Supply Co., has been appointed general credit manager, replacing **Dana J. Fox**, who is resigning to become president of Fretz-Moon Tube Co.

H. P. VALENTINE *H. COOKSTON* *J. M. CLEARY*

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Use the power of steam, air or water under pressure to lift liquids. Being simple jet pumps they have no moving parts and require no lubrication. A variety of models to meet different conditions. Also used as water heaters.

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diaphragm valves (SAUNDERS PATENT)

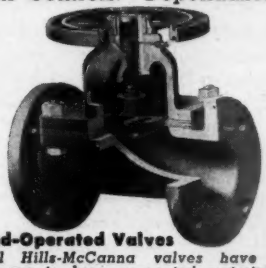
With Westinghouse Flex-air and Controlair Controls

HERE'S an efficient and practical way to control valve operations from any convenient point in your plant . . . with Hills-McCanna air-actuated valves. This unit combines the proved principle of the Hills-McCanna Diaphragm Valve with Westinghouse Flex-air and/or Controlair Controls and air-operated piston to give you smooth control . . . finger-tip service at all times.

And since this new Hills-McCanna unit . . . like all Hills-McCanna valves . . . *has no packing*, there's no sticking of the stem to interfere with easy, accurate positioning.

For ordinary open and close valve operation the Hills-McCanna unit is used with Flex-air Controls. Dependable throttling service may be had with Controlair and Flex-air Controls and a Hills-McCanna Diaphragm Valve and Piston operation.

This improved type valve is available in sizes from 4" to 12" inclusive. Send today for complete data on installation and operation.



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All Hills-McCanna valves have diaphragms to keep unwanted material out of the bonnet and to assure a leak-proof closure in shutoff position. The resilient diaphragm avoids sticking and clogging — eliminates packing — can be replaced quickly, easily, in a minimum of time.

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REFINING

Independent Refiners Seek Right to Acquire Plants

WASHINGTON.—Independent refiners who have operated government-owned aviation-gasoline plants should have an opportunity to acquire them on long-term credit arrangements, M. H. Robineau of Cheyenne, Wyo., told a Senate committee.

Robineau, head of Frontier Refining Co., which operated a 100-octane plant under lease, said that the independents, as well as major companies which have the money to buy the properties outright, should be entitled to purchase surplus plants with the aid of government financing.

Petroleum Administration for War allocated contracts to independent as well as major companies to prevent monopoly, he said, and it would be a mistake to put such rigid restrictions on sale of the plants that independents would be frozen out.

Republic Gasoline Plant at Texas City Reconverted

TEXAS CITY, Tex.—Republic Oil & Refining Co.'s 100-octane gasoline plant here was being reconverted this week. W. R. Holmsten, vice president and general manager, said operations would be resumed immediately upon completion of necessary changes. The refinery will have a payroll of about 400 men.

Holmsten said negotiations had been completed with Defense Plants Corp. for Republic to lease the unit for 90 days. At the end of that period it will be decided whether to make the lease permanent or shut down the plant. The unit was erected by DPC. It has a charging capacity of 12,000 bbl. daily.

Oil-Refining Project for Australia Announced

SYDNEY.—Organization of an oil-refining company in Australia, with 40 per cent of the capital of £1,250,000 subscribed by California Texas Co., has been announced. Prime Minister Joseph Chifley said the Australian Government had approved formation of the company on condition that 60 per cent of the shareholders be Australian; that the company import all raw materials on a sterling basis and that operations shall not involve dollars.

David Craig, prospective managing director of the new company—Bitumen & Australian Oil Refineries, Ltd.—said the new company's activities might make Australia self-supporting in lubricating oils and bitumen within the next 2 years. Much of Australia's bitumen comes from Tampico, Mexico.

Craig said crude oil could be brought from the Persian Gulf, which is in the sterling area, to be refined in Australia. Although the shareholders of California Texas—a subsidiary of The Bahrein Petroleum Co., Ltd.—are American, the company is registered in Nassau, Bahama Islands.

Cosden Seeks Competitive Rail Rates for Gasoline

ST. LOUIS.—A hearing was scheduled to be held here this week by the standing rate committees of Southwestern Freight Bureau and Western Trunk Line Committee on a proposal from Cosden Petroleum Corp. seeking adoption of rail rates on gasoline shipments from the Mid-Continent region to the Middle West which shall be competitive with pipe-line rates.

This is the latest in a long series of efforts looking to a reduction in

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rail rates on petroleum products from the Southwest. Cosden, which has refineries at Big Spring and Graham, Tex., contended that the setting of pipe-line competitive rail rates would yield railroads 700 carloads of new traffic a month, and until such rates are established the traffic may be considered as lost.

The company proposes a reduction of 8 cents a hundred pounds, or around ½ cent a gallon. It says its proposal would result in a corresponding reduction from all other related origin groups but would preserve origin grouping, destination grouping, and eliminate fourth-section difficulties.

Cosden says it knows of no reason why the proposed gasoline rates should cause reductions in rates for other petroleum products. It says the proposed rates would still be profitable.

It is stated the company is making "a very substantial capital investment" in its plant but it cannot be expected to depend on rail transportation to move its products if the rails cannot meet its transportation requirements at a profitable level of charges for service rendered."

Cosden declares the plans and operations of its refinery depend on the roads' decision.

Gulf Coast Gasoline Stocks Continue Upward Trend

HOUSTON.—Stocks of all grades of gasolines and naphthas at Gulf Coast Refiners Association plants rose 95,623 bbl. in the second half of October, standing at 1,559,641 bbl. at the close of the month. Automotive gasoline stocks totaled 814,905 bbl., up 11,854. Total stocks of all products totaled 3,651,614 bbl., up 204,375. A year ago these stood at 4,226,521. Crude runs during the second 2 weeks of the month aggregated 96,709 bbl. daily, which is 75 per cent of rated capacity.

Navy Returns Oil Refineries To Private Operation

WASHINGTON. — The Navy has returned to private operation three oil refineries which, along with about 50 others, were taken over by the Government October 5 because of labor trouble. The plants are those of Standard Oil Co. of Ohio, at Lima, Ohio; Sun Oil Co., at Toledo, Ohio, and Canton Refining Division of Central Pipe Line Co., at Canton, Ohio.

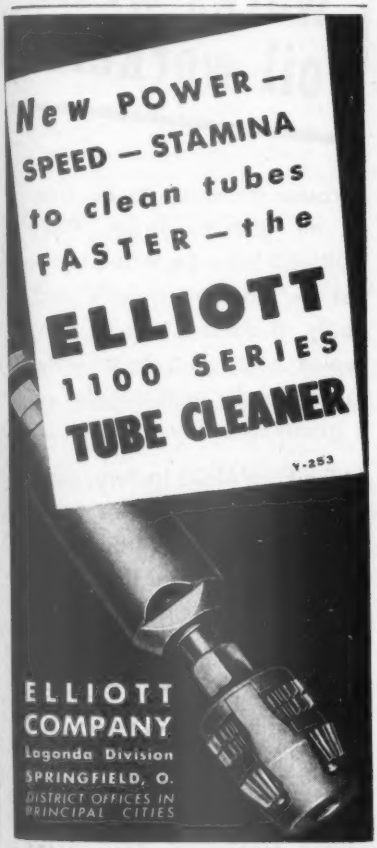
The action followed petitions by the three companies which stated that there were no labor disputes involving the plants. The Navy confirmed this statement.

Ohio Standard's employes at Lima belong to no union but the plant was taken over by the Navy because it was being picketed. The other Standard plants taken over are still under Navy control.

An agreement with International Oil Workers Union at Central Pipe Line's Canton refinery has been negotiated.

Sun's employes were not on strike when the plant was seized, but the Navy took it because, it was said, the threat of picketing might halt operations.

Little progress has been made in efforts to effect settlements at other plants.



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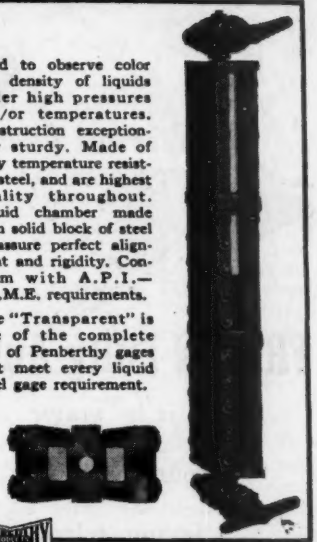

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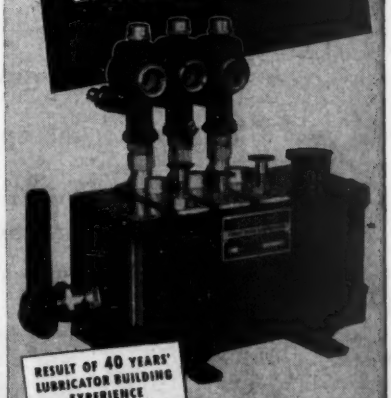

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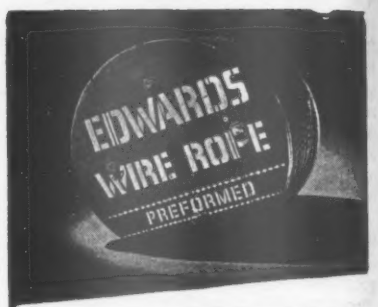

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Natural Gas

Wabash Public Service Is Acquired by Hoosier Gas

VINCENNES, Ind.—Wabash Public Service Corp. was purchased last week by Hoosier Gas Corp., following approval of the ownership transfer by Indiana Public Service Commission.

Wabash supplies natural gas to Bicknell, Wheatland, Monroe City, Petersburg, Francisco, and Oakland City, and owns extensive pipe lines throughout this part of Indiana. Hoosier will absorb the Wabash interests and continue service.

E. J. Meade, president of Hoosier, and his associates bought that corporation in November 1944. Vincennes will continue to be headquarters of the company which now supplies gas to Vincennes, Washington, and Princeton.

Reduced Rates Announced By Michigan Consolidated

DETROIT.—A reduction in natural-gas rates for 490,000 customers in the Detroit area, amounting to $3,961,000 annually, has been announced by Michigan Consolidated Gas Co., subsidiary of American Light & Traction Co. The new rates represent a cut of approximately 20 per cent. Average annual savings to small domestic consumers will amount to more than $7.

The reduction is the result of litigation started in 1942 by the city, county, and Michigan Public Service Commission. These groups obtained a Federal Power Commission order reducing pipe-line rates charged Michigan Consolidated for natural gas purchased from Panhandle Eastern Pipe Line Co. Detroit customers will share also in the distribution of $11,000,000 impounded since 1942.

Underground Storage Farm Planned by Consolidated

OKLAHOMA CITY. — Consolidated Gas Utilities Corp. with headquarters in this city, has asked Federal Power Commission for authority to create an underground natural-gas storage farm on the Sutcliffe structure of 1,200 acres in Wilson and Neosho counties, eastern Kansas.

The company plans to drill nine injection and withdrawal wells to a depth of 950 ft., and to construct a pipe line to connect with an 8-in. transmission line in Neosho County. Gas for storage is to be obtained from small wells now connected to the company's lines and from the Cities Service Gas Co.

Report on Conservation of Gas in Texas Postponed

AUSTIN.—The report on natural-gas conservation in Texas, to have been submitted by an industry engineering committee to the State Railroad Commission last week, has been postponed for approximately a month. This action followed a proposal made by Humble Oil & Refining Co. that operators in the Heyser field—center of the current investigation—join in an exhaustive study of field conditions. The proposal was approved by other operators, both majors and independents. There are 220 wells in the Heyser field, and the question at issue is whether gas produced with oil should be returned to the producing horizon.

Permission Sought to Build Blythe-to-Los Angeles Line

WASHINGTON. — Federal Power Commission has received a joint application from Southern California Gas Co. and Southern Counties Gas Co. of California, affiliates, with headquarters in Los Angeles, for permission to construct a 214-mile, 26-in. natural-gas pipe line between a point on the Arizona-California boundary near Blythe, Calif., and Santa Fe Springs, near Los Angeles. At Blythe the proposed line would connect with another line, which El Paso Natural Gas Co. proposes to construct from the Hugoton and Panhandle gas fields in Texas and various fields in the Permian basin area in Texas and New Mexico. At Santa Fe Springs it would connect with a 26-in. line extending to Los Angeles, which latter line is now in course of construction by the applicants.

Equitable Denied Authority To Increase Gas Rates

HARRISBURG, Pa.—Rates of Equitable Gas Co. remain unchanged following refusal of the state's Public Utility Commission to recede from the order it issued last July denying the company's request. The commission dismissed exceptions filed by the company and the city of Pittsburgh to the original order and made it final.

The action closes not only the proceedings involving the proposed increase but another instituted by the commission to investigate reasonableness of existing gas rates.

Hope to Spend $2,000,000 In Development Project

CLARKSBURG, W. Va. — Hope Natural Gas Co. is planning to spend $2,000,000 in the development of gas wells in West Virginia at points "from Marion to Wyoming counties inclusive," Superintendent John A. Clark says. The project includes drilling of 50 gas wells, principally in the company's new Wyoming County field, and building of 40 miles of pipe line.

Referring to Wyoming County, Clark said, "That is where all our new development is being done and that is where the gas will be coming from during the next 20 years."

Kentucky Natural's Petition For Rehearing Denied

WASHINGTON. — Federal Power Commission has denied petitions filed by Kentucky Natural Gas Corp. for rehearing on the commission's order of September 7, which (1) authorized Central Illinois Public Service Co. to construct 20 miles of 6-in. pipe line to enable it to obtain its natural-gas directly from Panhandle Eastern Pipe Line Co. to meet requirements of customers in the Mattoon, Ill., area, and (2) dismissed an application of Kentucky Natural to construct similar facilities for augmenting the supply of natural gas sold to Central Illinois.

"No new facts or principles of law have been presented," says FPC.

Central Illinois purchases natural gas for its Mattoon area from Kentucky Natural at a point on the Illinois-Indiana state line. Kentucky Natural, in turn, receives its supply from Panhandle Eastern. To increase its present capacity to the extent required with natural gas purchased from Kentucky Natural it would be necessary for Central Illinois to expend at least $350,000 for additional pipe-line facilities, whereas its estimated cost of the proposed new interconnection with Panhandle Eastern will be about $182,900. The proposed 6-in. line between Tuscola and Mattoon will have a capacity adequate to meet the estimated requirements of Central Illinois in the Mattoon area through 1950.

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PIPE LINES

Humble Initiates Airplane Pipe-Line Patrol

HOUSTON. — Humble Pipe Line Co. has initiated airplane pipe-line patrol over a part of its network of lines. The pilot inspector makes his rounds in a two-place Luscombe plane. From his window as he flies at 500 ft. or less, he scans the ground for telltale oil spots or other indications where attention of a repair crew is needed.

The section of line patrolled is about 915 miles long, requiring 1,050 miles of flying. It takes the pilot inspector 2 days to make the route on one patrol.

One man will be able to patrol an area formerly covered by several line walkers, and these line walkers will be transferred to other positions in the company.

The first pilot inspector is R. R. Roberts, veteran of 23 years with Humble and for years district gager in the Mexia area. He will inspect pipe lines from Baytown to McCamey in West Texas via Webster, Hearne, Comyn, San Angelo, and Big Lake, returning via Yates Pecos, Big Lake, Humble Pipe Line Station C which is about 40 miles from Kerrville, Seguin, Luling, West Columbia, and back to Webster. Scheduled fueling stops are Waco, McCamey, and Seguin, Tex.

Until the company is able to secure a wave length and equipment for operating its own two-way communication system between the plane and the pipe-line pump stations, a system of signals will be used.

Government Operation of WEP Opposed by Jones

All surplus oil facilities commercially usable should be sold, according to a statement presented by W. Alton Jones, president, War Emergency Pipelines, Inc., to a hearing in Washington, D. C., of the special committee investigating petroleum resources. The question of whether the WEP systems should be shut down, leased, or sold has been the subject of considerable debate in Congress.

Jones suggested that the money expended by the Government for constructing these lines could well be charged to the cost of conducting the war since their costs have been more than recovered by savings to the Government in the cost of moving oil to the East Coast.

Speaking as chairman of an industry committee, Jones summarized its recommendations as follows:

1. The Government should discontinue operating surplus facilities because "free enterprise cannot endure with Government as a competitor."

2. Facilities "commercially and economically usable in normal peacetime operations should be sold." Plants should not be leased to

Humble Pipe Line Co. superintendents meeting the pilot of the first plane scheduled for pipe-line patrol duty between Baytown and McCamey, Tex., on its recent arrival at the Houston municipal airport. R. R. Roberts, pilot; H. M. Stevenson and F. D. McMahon, assistant general superintendents; A. E. Payne, superintendent of southern division; and F. O. Perry, district superintendent, Pierce Junction, Tex.

private operators because this "would in effect continue the Government in business."

3. Facilities not commercially usable should be closed, but "adequately protected so that they would be immediately available in the event of another emergency."

4. "Sale of surplus facilities should be handled in such a manner as not to disrupt the normal functioning of the industry."

5. "Facilities should not be sold on a basis which would give purchasers unfair competitive advantages."

6. "No sales should be made which tend to create monopolies. For example, if utilized at all for oil transportation, government pipe lines must operate as common carriers, available to all independents as well as to the major companies."

7. "For the most part these government-built plants and facilities have served their purpose. They are, in a sense, expendables. . . . We try to salvage, to reclaim waste. This is right and proper but perspective should be preserved. We should not lose sight of the larger peacetime objective, a greater national income, productive work for anyone who wants it, the nation's solvency preserved."

Following the statement by Jones, several other executives presented testimony before the Senate committee; these included the following: Sidney A. Swensrud, vice president, Standard Oil Co. (Ohio); H. Holley Poe, natural-gas analyst; A. L. Christy, Pure Oil Co.; T. E. Swigart, Shell Pipe Line Corp.; J. A. McNeath, Humble Oil & Refining Co.; Paul G. Blazer, Ashland Oil & Refining Co., and Fayette B. Dow, National Petroleum Association.

The committee was told that four other government pipe lines have no economical postwar use. They are certain Defense Plant Corp. projects designated as the Florida, Ohio, Plantation, and Southwestern. It was recommended that they be junked, and the property sold for salvage.

The two WEP lines have been filled with water, but early in December they will be filled with air.

Interstate to Lay Mattoon Outlet

A pipe-line connection for the Mattoon oil field, southwest of Mattoon, Ill., is assured by plans of Interstate Oil Pipe Line Co., Tulsa, to extend service to the field.

L. F. Kahle, Interstate executive vice president, and Bruce Ramsey, vice president in charge of the northern division, jointly announced the company's intention of laying 19 miles of 8-in. line connecting the field with the Montrose pumping station on Ohio Oil Co.'s main line south of Mattoon. Initial survey work is under way.

Currently the field's production is being moved by truck and tank car.

Metropolitan Eastern Prepares for Hearing

Metropolitan Eastern Corp. is preparing to present its case before Federal Power Commission on January 15, 1946, in regard to its application to build an 825-mile line natural-gas pipe line from the Carthage, Tex., area to a point near Cincinnati. Affairs of the organization are reported to be handled by Chester A. Ring and Ralph Holmes, 50 Church St., New York.

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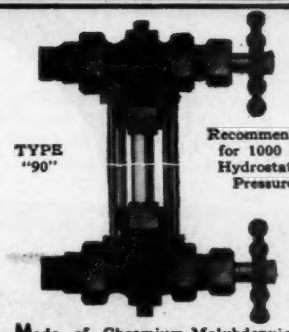

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Exploration and Drilling

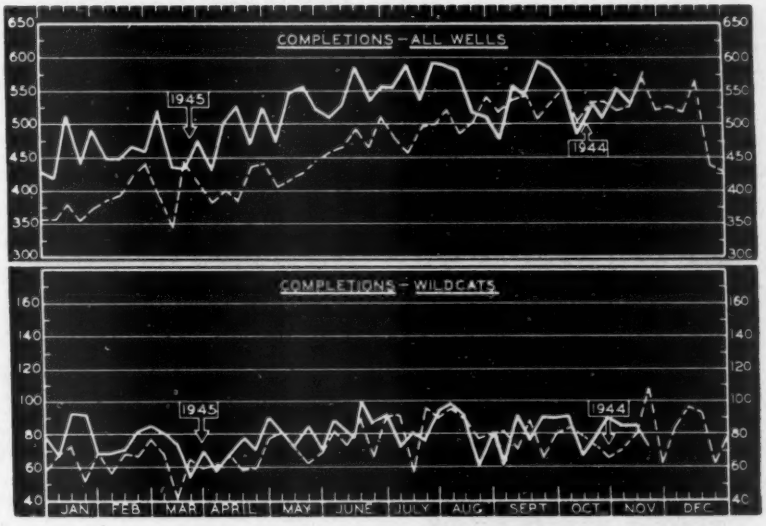
Week's Highlights

SHELL OIL CO. OF CANADA 10-14-J, LSD 14-25-5w5, second test on the Jumping Pound structure, some 25 miles northwest of the north end of the famous Turner Valley field, is a geological success and a dry hole.

This wildcat, one of the most important in Canada, is the second test of a structure on which the discovery had produced gas and condensate near the top. It was deliberately aimed at catching the Madison lime about 1,000 ft. lower on the structure than the discovery. Reaching the top of the Madison at 10,639 ft., it was exactly 1,018 ft. lower than the first well, which is geological sharpshooting, and following lines of first-class geological reasoning. Yet the payoff is salt water.

Since December 1944, the first well, under heavy back pressure, has produced over 400,000,000 cu. ft. of gas for drilling fuel, and about 3,000 bbl. of condensate. It has penetrated about 120 ft. of pay below the top of the Madison and has shown no signs of water.

The geological problem still remains. We know only that Jumping Pound will produce through 120 ft. of pay and will not produce, at least on the west side, through as much as 1,000 ft. of closure. Turner Valley produced through about 4,500 ft. of closure on the west side and about 5,500 ft. on the east side. Therefore, at least as far as the west side of Jumping Pound is concerned, it is not another Turner



Solid line charts current weekly completions—service wells included

WEEKLY WELL COMPLETIONS . . . WEEK ENDED NOVEMBER 17, 1945

	Total of all wells					Cum. to date		Wildcat completions and discoveries					Cumulative total, 1945				
	Comp.	Oil	Gas	Dry	Footage	1945	1944	Oil	Dist.	Gas	Dry	Total	Oil	Dist.	Gas	Dry	Total
New York	30	15	0	*15	43,800	1,299	1,425	0	0	0	0	0	0	0	0	0	0
Pennsylvania	65	30	6	†29	117,850	3,581	3,741	0	0	0	0	0	0	0	0	0	0
West Virginia	18	2	11	5	45,315	709	797	0	0	0	0	0	0	0	0	0	0
Ohio	23	5	10	8	69,837	869	893	0	0	0	2	2	0	*0	14	55	69
Indiana	6	3	0	3	11,294	172	229	1	0	0	0	1	7	0	0	24	31
Kentucky	25	20	1	4	47,371	499	662	0	0	0	0	0	23	0	4	46	73
Illinois	32	22	0	10	83.354	1,597	1,701	1	0	0	4	5	48	0	0	279	327
Michigan	15	6	1	8	38,462	671	604	0	0	0	4	4	11	0	4	250	265
Kansas	40	21	6	13	132,089	1,534	1,636	0	0	1	4	5	33	0	13	299	345
Neb., Mo., Iowa	0	0	0	0	0	20	35	0	0	0	0	0	0	0	0	14	14
Oklahoma	53	30	9	14	208,492	2,114	1,620	0	0	1	8	9	76	3	16	313	408
Texas	165	78	40	47	700,818	6,322	4,968	4	0	0	26	30	185	14	50	1,115	1,364
North Central	46	22	1	‡23	114,174	1,921	1,300	1	0	0	11	12	70	0	5	393	468
West	38	23	9	6	151,326	1,547	1,407	1	0	0	4	5	47	1	0	223	271
Panhandle	23	2	21	0	67,410	493	254	0	0	0	0	0	0	0	1	6	7
Eastern	15	7	7	1	83,603	329	286	1	0	0	1	2	6	8	2	75	91
Gulf Coast	33	19	2	12	233,467	1,474	1,119	1	0	0	7	8	48	4	33	256	341
Southwest	10	5	0	5	50,838	558	602	0	0	0	3	3	14	1	9	162	186
Louisiana	35	18	3	14	264,323	956	713	0	1	0	4	5	31	4	6	112	153
Northern	17	8	3	6	92,847	402	286	0	0	0	4	4	8	1	6	65	80
Southern	18	10	0	8	171,476	554	427	0	1	0	0	1	23	3	0	47	73
Arkansas	6	5	0	1	27,337	160	195	0	0	0	1	1	2	0	0	34	36
Mississippi	7	4	0	3	50,498	324	134	0	0	0	3	3	6	0	0	108	114
Southeastern States	2	2	0	0	7,246	53	44	0	0	0	0	0	1	0	1	35	37
Montana	10	6	2	2	21,670	282	316	0	0	0	0	0	10	0	0	24	34
Wyoming	4	3	0	1	13,743	195	153	1	0	0	1	2	18	0	1	43	62
Colorado	2	2	0	0	12,844	50	31	0	0	0	0	0	1	0	1	11	13
New Mexico	6	5	0	1	19,818	373	355	0	0	0	0	0	10	0	6	59	75
California	34	27	2	5	118,180	1,989	1,771	0	0	0	4	4	4	0	2	208	214
Total United States	578	304	91	183	2,034,341	23,759	22,023	7	1	2	61	71	466	21	118	3.029	3,634
Total previous week	528	282	51	185	1,763,265	23,181	21,438	16	0	1	68	85	459	20	116	2.968	3,563
Total Nov. 18, 1944	575	302	41	232	1,886,317	22,023	15,731	14	0	2	93	109	401	26	111	2,867	3,404

Service wells included: *15; †25; ‡1.

Valley. The structure is so steeply folded, however, that 120 ft. of pay closure will not net much acreage. The second well, taking in about 900 ft. downdip, is only five-eighths of a mile from the discovery.

Shell must make some hard decisions; whether to drill several 11,000-ft. wells, either to test the east flank of the structure, or to determine just where the water-oil contact lies on the west flank, between the proven 120 ft. and the known water level some 900 ft. lower. Or, if the discovery well is in mechanical shape for deepening, whether to gamble on ruining it by attempting to deepen until the water level is found.

MICHIGAN

Deep River Gets Two 300-Bbl.-Per-Hour Wells

SAGINAW.—J. E. Bauer and Ervin Major each brought in 300-bbl.-per-hour wells in Arenac County's Deep River oil field as features of the week's developments. With another Deep River completion rated at 120 bbl. per hour, these three wells provided most of the 18,000-bbl. increase in daily potential as 15 tests were completed and 12 new locations announced. Completions included six producers, one small gas well and eight dry holes, four of them being wildcat tests. Four of the new locations are in Clare County, three listed for Winterfield natural gas development. Two others are in Arenac, two in Allegan, one each in Gratiot, Montcalm, Ottawa and Newaygo.

MICHIGAN WILDCAT FAILURES

Isabella County, Chippawa Township: Sohio 1 Vodicka et al, SE SE SE 17-14n-3w, dry in Rainbo, TD 3,805 ft.

Coldwater Township: Union Drilling & Producing 1 Conley, SW NE SW 23-16n-6w, dry in Dundee, TD 3,899 ft.

Mecosta County, Green Township: Gordon Oil 1 Rauch, E½ NE NE 1-16n-10w, dry in Monroe, TD 3,726 ft.

Van Buren County, Arlington Township: Stuart L. Godfrey 1 Steinman, NW NW NW 6-2s-15w, dry in Traverse limestone, TD 1,152 ft.

SOUTHWEST TEXAS

Atascosa Wildcat Drill-Stem Tests Gas-Cut Mud

CORPUS CHRISTI.—In Atascosa County, ¾ mile southwest of Jourdanton, Humble Oil & Refining Co. 1 Henry Schorsch, a wildcat in Edward Esteda Survey, recovered gas-cut mud on drill-stem test at 7,329-35 ft. in the Edwards lime. Some condensate is also reported to have shown.

Humble 1 W. S. Murpny, wildcat in S. J. de Carricitos Grant, Gulf Coast Irrigation Co. Subdivision, a mile north of San Perlita, in Willacy County, reperforated pipe at 10,490-96 ft. and ran drill-stem test which recovered muddy salt water. A series of tests have been run below the 10,900-ft. level but so far none of them have indicated possibilities of commercial production. Total depth is 11,207 ft. with 5½-in. casing set to bottom.

Blanco Oil Co. and Al Buchanan 1 John J. Power et al, wildcat in the Jose Manuel Blanco & Power & Hewitson Survey, 10 miles north of Refugio and 2 miles southwest of the Gaffney field in Refugio County, is preparing to run electric log to total depth 4,750 ft. This test had failed to find any shows in the Greta section at 3,875-3,930 ft.

Humble 2 B. A. Skipper, in La Encantada Grant, wildcat 1½ miles northwest of Rachal in Brooks County, ran an electric log to total depth 8,001 ft. in hard shale, and was dry.

There were 33 new locations reported this week with 4 being wildcats, 2 in Bee County and 1 each in Duval and Zavala counties. Of the 26 completions this week 7 are dry wildcats, 1 each in Bastrop, Bexar, Brooks, Calhoun, San Patricio, Starr, and Victoria counties. Starr County led this week with six completions reported.

SOUTHWEST TEXAS WILDCAT FAILURES

Bastrop County: Continental 1 Willie Malina, Andrew Graham Sur., 4½ mi. N Cistern, dry at 9,276 ft.

Bexar County: Geo. Parker and Chas. L. McCune 1 T. J. Goad, J. M. Urriegas Grant, 10 mi. S San Antonio, dry at 4,400 ft.

Brooks County: LaGloria Corp. 1 Mary Powers estate, GC&SF Sru. 313, 25 mi. SW Falfurrias, dry at 6,018 ft.

Calhoun County: Humble 1 Mrs. Maude B. Traylor, in Wolf Point area, Juan Maldonado Grant, 5 mi. from Olivia, dry at 10,183 ft.

San Patricio County: Southern Minerals Corp. 1 A. J. Wheeler, T. T. Williamson Sur. 33, 2 mi. W Ingleside, dry at 7,466 ft.

Starr County: W. L. Goldston 1 Roos & Bennett, Porcion 93, Share 100, 10 mi. NE Rio Grande City, dry at 4,700 ft.

Victoria County: Sterling Oil & Refining 1 J. J. Welder, in Day Land & Cattle Co. Sur., Abst. 477, 3 mi. E Nursery, dry at 6,530 ft.

TEXAS GULF COAST

New Oil Field Opened In Brazoria County

HOUSTON.—A new oil field in Brazoria County, 11 miles southwest of Angleton, has been opened by Ernest Cockrell 3 Seaburn estate heirs, in the Jared E. Groce 5 League Grant. This well gaged 231 bbl. of 25-gravity oil in 24 hours through a ¼-in. choke, through 60 perforations at 3,956-66 ft. in sand topped at 3,940 ft. Tubing pressure is 510 lb., casing on seal. Gas-oil ratio is 271 to 1, and no water. The original hole was drilled to a depth of 3,186 ft. and hit the dome at 3,123 ft. Operators then plugged back and sidetracked and drilled to total depth of 3,970 ft.

In the southeast extension area of Fannett field, Jefferson County, Gulf Oil Corp. 7-A Junker-Spencer gaged 249 bbl. of pipe-line oil daily through a 9/64-in. choke. Total depth is 7,712 ft. with 5½-in. casing set at 7,697 ft. Top of sand was 7,334 ft., perforations at 7,334-52 ft., tubing pressure 1,090 lb., gas-oil ratio 625 to 1, and gravity 35°.

Jack W. Fraier and C. A. Wiggins 1 Great Southern Life Insurance Co., wildcat in the West Lochridge area of Fort Bend County, has been plugged. Total depth of the hole is 6,410 ft. in shale. Sandy shale sections at 6,300-12 ft., and trace of oil was found in sand at 6,317-18 6,313-17 ft. had gas odor, and a slight ft.

Goldrus Drilling Co. et al 1 Edward G. Geheb, wildcat test about 5 miles southeast of China in Jefferson County, HT&B Survey 11, has been plugged. This test was drilled to a total depth of 8,879 ft. in hard sandy shale. Electrical logs were run but no shows were recorded.

There were 18 new locations reported this week, 1 being a wildcat in Wharton County. Of the 17 completions, 4 were wildcats, 1 a new oil pool discovery in Brazoria County and 3 dry holes, 1 each in Chambers, Fort Bend and Jefferson counties. Fort Bend and Jefferson counties showed more activity with three completions each.

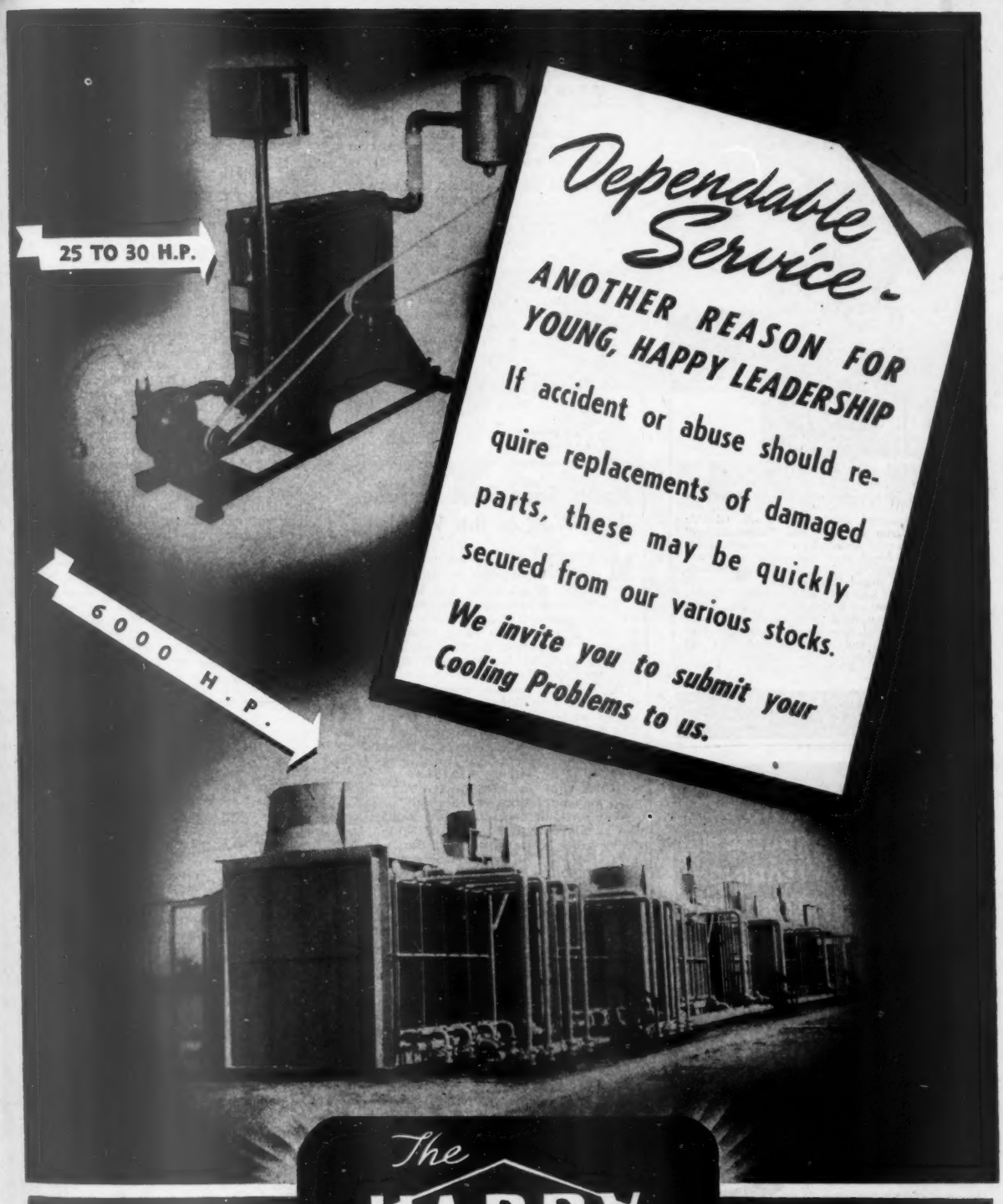
UPPER GULF COAST SUCCESSFUL WILDCAT

Brazoria County: New oil pool—E. Cock-

DAILY AVERAGE PRODUCTION FOR WEEK

	Nov. 17 crude oil	Bureau of Mines demand forecast	State allowable	Nov. 10 crude oil
Alabama	550	100	.....	550
Arkansas	76,050	78,000	.....	76,100
California	832,500	860,000	880,000	835,250
Colorado	15,000	12,000	.....	15,400
Eastern	61,450	65,200	.....	66,300
Florida	100	200	.....	100
Illinois	204,100	215,000	.....	206,300
Indiana	13,500	13,500	.....	13,800
Kansas	267,350	270,000	255,000	243,800
Kentucky	29,400	28,000	.....	28,450
Louisiana	368,400	365,000	398,733	367,800
North Louisiana	74,750	.....	.....	74,150
South Louisiana	293,650	.....	.....	293,650
Michigan	45,850	47,000	.....	47,200
Mississippi	54,150	48,000	.....	53,500
Montana	22,650	23,200	.....	22,700
Nebraska	750	800	.....	750
New Mexico	101,600	102,000	104,000	101,550
Oklahoma	388,700	390,000	390,000	390,150
Texas	1,894,700	1,990,000	2,016,198	1,894,700
East Texas	316,500	.....	.....	316,500
East Central Texas	128,000	.....	.....	128,000
North Central Texas	147,100	.....	.....	147,100
Texas Panhandle	81,000	.....	.....	81,000
West Texas	457,750	.....	.....	457,750
Southwest Texas	300,100	.....	.....	300,100
Texas Gulf Coast	464,250	.....	.....	464,250
Wyoming	90,700	92,000	.....	95,250
Total United States	4,467,500	4,600,000	.....	4,459,650
Change from prev. week, up	7,850			

Total production January 1-November 17, 1945 ..... 1,507,254,925 bbl.
Same period last year ..... 1,465,391,600 bbl.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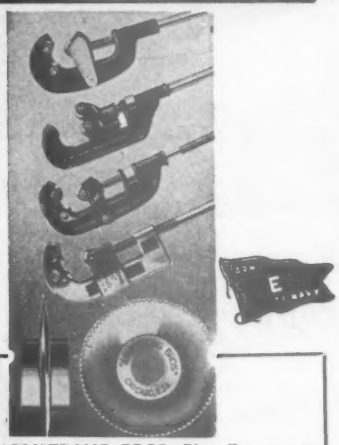

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rell 3 Seaburn estate heirs, Jared E. Groce 5 League Grant, 11 mi. SW Angleton, TD first hole 3,186 ft., hit dome 3,123 ft., plugged back and drilled to TD 3,970 ft. in sidetracked hole, top sand 3,940 ft., perf. 3,966-66 ft., PT 232 bbl. 24 hours through ¼-in. choke, gas-oil ratio 271, tubing pressure 510 lb., casing sealed, gravity 25°, no water.

UPPER GULF COAST WILDCAT FAILURES

Chambers County: Standard of Texas 1 State of Texas, in Galveston Bay, Section 292, 3 mi. E Seabrook, dry at 10,001 ft.

Fort Bend County: Jack W. Frazier and C. A. Wiggins 1 Great Southern Life Insurance Co., Edward Robertson League, 5 mi. NW Lochridge, dry at 6,410 ft.

Jefferson County: Goldrus Drilling et al 1 Edward G. Geheb, TT&B Survey 11, Abst. 148, 5 mi. SE China, dry at 8,879 ft.

ILLINOIS

North Boos Pool Supplies Best Well of the Week

MATTOON.—Thirty-two wells were reported completed in Illinois in the past week, 22 oil wells and 10 dry holes.

The largest new producer was Pure Oil Co. and Lynn 1 Long-C, S½ NE NW 9-6n-10e, in the North Boos field in Jasper County. Producing from Rosiclaire lime, topped at 2,696 ft., the well flowed 861 bbl. the first 24 hours.

Lario Oil & Gas Co. opened a new productive spot in White County with a relatively small producer, 1 E. Organ, NW NW NE 35-4s-9e, a 35-bbl. pumper. It had been drilled to 3,379 ft. and plugged back to 2,617 ft. and shot in Tar Surings sand at 2,570-77 ft., then at 2,604-14 ft., with a third shot at 2,568-75 ft. Four other wildcat completions were dry.

The Mattoon pool, in Coles County, saw five wells completed, one of which was a dry hole, Walter Duncan 2 Sanders, NE SW NE 34-12n-7e, which was given up at about 2,010 ft. Same operator completed a 300-bbl. producer in 3 Wallace, NW NW NE 27-12n-7e, in Aux Vases sand at 1,958-70 ft. Carter Oil Co. 3 Ganley, NE NW NW 2-11n-7e, started at 300 bbl. per day from Cypress sand at 1,802-32 ft., and H. E. Gordon completed a 200-bbl. well 1 D. M. Sawyer, NE SW SE 34-12n-7e, in Cypress sand at 1,795-1,812 ft. and Aux Vases at 1,958-66 ft.

Thirty-seven new operations were reported during the week, among them six wildcat starts: A. Y. Bradley et al 1 Cramer, SE SE SE 35-13n-7e, and Ben Nation 1-A Clark, NE SW NW 32-12n-8e, both in Coles County; Sohio Petroleum Co. 1 J. Conrad, NE NE NW 26-5n-6w, Madison County; Ryan Oil Co. 1 Parrott, SE NW NW 14-2s-2w, Washington County; Ryan Oil Co. 1 Higginson Heirs, NE NW NE 22-9s-10e, White County, B. A. Baker 1 J. B. Holbrook, Heirs, SW SW NW 13-9s-7e, Saline County.

ILLINOIS SUCCESSFUL WILDCAT

White County: Lario Oil & Gas 1 E. Organ, NW NW NE 35-4s-9e, pumped 38 bbl. oil, 40-qt. shot 2,604-14 ft., 20-qt. shot 2,568-75 ft., Tar Springs 2,570-77 ft., TD 3,379 ft., PB 2,617 ft.

ILLINOIS WILDCAT FAILURES

Clay County: Nation Oil Co. 1 A. Owens, SW SW NE 3-4n-5e, dry and abandoned at 2,701 ft., Benoist 2,458 ft., Aux Vases 2,499 ft., McClosky 2,632 ft.

Coles County: Geo. S. Engle 1 H. Hortenstein, SW NE SE 5-12n-8e, dry and abandoned at 2,220 ft., Aux Vases 2,078 ft., Fredonia 2,176 ft.

Crawford County: Ed Greck & Truitt 1 F. Goodwin, SW NE SE 22-7n-11w, dry and abandoned at 1,005 ft., sand 890-911 ft., 937-1,005 ft.

Jefferson County: John Darlan 1 CB&-QRR, SW SW NW 21-1s-1e, dry and abandoned at 2,413 ft., Cypress sand 1,964 ft., Benoist sand 2,170 ft., McClosky 2,375 ft.

EASTERN TEXAS

8,000-Ft. Wildcat Test Planned for Houston Co.

DALLAS.—A. G. Hill et al 1 Mrs. J. P. Mason is a new wildcat for Houston County, 6 miles southeast of Grapeland. It is planned to drill to 8,000 ft. to the Woodbine sand. It is 660 ft. from the northeast line and 1,385 ft. from the southeast line of the Stephens Hatton Survey. Rogers Lacy and Allied Oil Co. 1 Scott, Johnson Survey, wildcat 3 miles southwest of Jefferson, Marion County, was drilling below 6,770 ft. with no shows. Humble Oil & Refining Co. 1 Pickering Lumber Co., Francois Survey, wildcat in the Huxley area, Shelby County, having lost returns several times recently, has set retainer and cemented plug again with 500 sacks of cement. Total depth is 10,986 ft.

Delta Drilling Co. 1 Livingston, Nacogdoches University Survey, wildcat 3 miles southeast of Reilly Springs, southern Hopkins County, after finding salt water in the Paluxy sand at 6,245 ft., was drilling below 6,752 ft. in shale and sand with no shows. Humble 1 Gerow, SA&MG Survey, wildcat 4 miles north of Talco.

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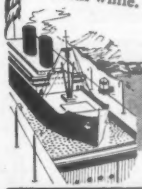

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Franklin County, is dry at 5,432 ft. in the Paluxy sand.

Carthage field, Panola County, had seven completions this week. Hawkins field, Wood County, reported six locations and Merigale field, Wood County, two.

EASTERN TEXAS SUCCESSFUL WILDCAT

Cherokee County: New oil pay—H. W. Walker et al 1 P. I. Bowling, W. H. Walker Survey, Lone Star field, elev. 357 ft., pumped and flowed 169 bbl. day through 2-in. tubing, perf. 3,348-84 ft. Nacatoch, gravity 41°, TD 8,370 ft.

EASTERN TEXAS WILDCAT FAILURE

Navarro County: E. J. Moran 1 First National Bank of Corsicana, T. O. Jones Sur., 15 mi. NE Corsicana, elev. 358 ft., Woodbine 2,812 ft., dry, TD 3,225 ft.

CALIFORNIA

Four Wildcats Now Drilling in Bandini Area

LOS ANGELES.—Richfield Oil Corp. has stopped drilling in 1 Union Pacific in the Bandini wildcat area at 8,608 ft. and will land pipe before drilling ahead. Richfield has clarified the status of this wildcat to some extent by explaining that several thin oil sand lenses have been cored during the past several hundred feet but that it is questionable whether enough sand has been picked up to make a commercial well. Of all the many wildcats drilled in the Bandini area during the past 20 years, Richfield's 1 Union Pacific is by far the best looking prospect. There are four wildcats under way in the Bandini area at present, all within a radius of a few miles. Chanslor Canfield Midway Oil Co. is prospecting in section 21-2s-12w. C. G. Willis is drilling a wildcat in Section 23-2s-12w, and Richfield has two wildcats under way, one in Section 9-2s-12w, and another in Section 15-2s-12w.

Despite reports to the contrary, Ohio Oil Co. has not officially completed its Gardena wildcat and will proceed with further testing in an effort to shut off water. It is generally admitted that Ohio apparently has found an oil field at Gardena but it may take another well to definitely prove up its holdings. The present wildcat, on its many tests, has shown the presence of oil, and water is the only thing that has been holding up completion of the discovery well.

Standard Oil Co.'s Lefingwell wildcat between Santa Fe Springs and West Coyote is drilling ahead below 11,000 ft. and will probably be carried down as a deep conclusive test. This wildcat is located in an area that contains great thicknesses of Pliocene and Miocene rocks and therefore it is possible that any substantial amount of sand may prove productive. At Buena Park, Texas Co. found the Bell sand equivalent (Pliocene) around 11,000 ft. and indications point to the probability that the Lefingwell area will not require such deep drilling. Standard has penetrated the Miocene although the Pliocene-Miocene contact is unknown. This wildcat, however, had small amounts of oil sand at 6,915 ft., 7,874 ft., 8,600 ft., 9,100 ft. and 10,200 ft., indicating the possibility the showings might have extended from the Pliocene into the top of the Miocene.

In the Race Track area of Kern County, the latest completion of Kern Oil Co., 37-34, was completed flowing 1,320 bbl. daily rate and actually produced 200 bbl. per day through a 2/64-in. bean. The remarkable thing in connection with this completion is the fact that production

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came from a 5-ft. interval at 4,640-45 ft. Schist zone development continues at Edison and with a number of completions scheduled for the next 2 weeks, field production can be expected to respond simultaneously. Additional drilling is also increasing in the Cymric area both in the Union area and the Oceanic district.

CALIFORNIA WILDCAT FAILURES

Kern County, Jasmine: Tide Water Associated 41 Carver, 19-25s-28e, bottomed in basement granite, Pyramid Hills sand 1,450 ft., Vedder sand 1,618 ft., top granite 1,763 ft., all sand barren, TD 1,803 ft.

Round Mountain: Trico Oil & Gas 3 Olcese, 17-28s-29e, bottomed in barren gray sand, top Vedder sand 2,310 ft., Vedder was barren, TD 2,342 ft.

Shale Hills: B. C. Morrison 2 Mountford, 18-27s-19e, bottomed in hard gray sand, no showings of importance, TD 3,004 ft., dry.

Los Angeles County, Castaic: O'Kane & Brain and Barnsdall 1 Castaic, 17-5n-16w, bottomed in hard gray sand, all tests were wet, TD 3,184 ft., dry.

N. CENTRAL TEXAS

Young County Wildcat Brought Under Control

WICHITA FALLS.—L. T. Burns 1 Kunkel, Block 169, TE&L Survey, wildcat 2½ miles southwest of Olney, northern Young County, was brought under control after blowing out and flowing wild for over 24 hours. The flow was estimated to be between 250 and 1,000 bbl. per hour. The operator poured 1,600 sacks of Baroid in the hole before he succeeded in stopping the flow. The test had been drilled to 4,899 ft. Mississippian was topped at 4,890 ft. Operator is conditioning hole to run pipe.

National Associated Petroleum Co. 1 Alexander A. Buffington Survey, northwestern Montague County wildcat 2 miles south of Nocona, drilled porous lime with odor of oil at 4,971-82 ft. A 30-minute drill-stem test at 4,971-99 ft. was run and 100 ft. of oil-cut mud was recovered. It is drilling below 5,240 ft. in sandy shale. Standard Oil Co. of Texas 1 Beasley, J. M. Kerley Survey, in the Sivells Bend pool of northern Cooke County, ran a drill-stem test at 6,370-90 ft. in the Strawn and recovered 390 ft. of oil and 360 ft. of heavily oil-cut drilling mud. Operator was preparing to run another drill-stem test.

Archer County had seven field completions this week, Wichita and Young counties each had five and Cooke County four. Cooke and Wichita counties each reported eight new field locations and Montague County six.

NORTH CENTRAL TEXAS SUCCESSFUL WILDCAT

Cooke County: Extension to old oil pool—Owen W. Murray 1 A. T. Gregory, J. M. Randolph Sur. A-868, Almon pool outpost, elev. 900 ft., pumped 141 bbl. day, perf. 3,482-86 ft. Strawn, gravity 30°, TD 3,486 ft.

NORTH CENTRAL TEXAS WILDCAT FAILURES

Archer County Wood & Dillard 2 J. S. Melugin, Sec. 1, SPRR Sur. A-406, ½ mi. E Archer City, elev. 1,088 ft., dry, TD 1,111 ft.

Featherstone & Donohoe 1 Severne Frerich, Sec. 3, Blk. 64, Clark & Plumb Subd., 2 mi. S and 3 mi. W Scotland, dry, TD 1,284 ft.

J. F. O'Donohoe et al 1 B. W. Garvey, Sec. 1870, TE&L Sur., 5 mi. E and 1½ mi. N Westfork, elev. 1,128 ft., dry, TD 1,000 ft.

Clay County: G. E. Kadane & Sons 1 J. Hoff, Lot 54, Blk. 2, Clark & Plumb Subd., 1 mi. S and E Windthorst, dry, TD 3,910 ft.

Cooke County: W. H. Peckham 1 W. M. Thomason, T. Bell Sur. A-52, 1 mi. S and 1½ mi. E Leo, elev. 738 ft., dry in Schist, TD 2,281 ft.

Seitz, Comegys & Seitz 1 Mac Williams Wm. C. Mathews Sur., 1 mi. S and 2 mi. W Collinsville, elev. 654 ft., Ellenburger 3,594 ft., dry, TD 3,750 ft.

Jack County: Chalmette 1-A Katie Bell Carpenter, Chas. Covington Sur. A-1514, 6 mi. N and W Jacksboro, elev. 1,152 ft., Mississippian 5,638 ft., Ellenburger 5,822 ft., dry, TD 5,845 ft.

Montague County: G. E. Kadane 1 Kiel & Junk, W. Wallace Sur. A-841, ½ mi. S Bonita, dry, TD 5,560 ft.

Wichita County: Scott Bros. 2 L. MacKechney, Leag. 2, Blk. 18, Denton CSL A-57, 3 mi. E and 2 mi. N Holliday, dry, TD 1,263 ft.

WEST CENTRAL TEXAS

ABILENE.—Sohio Petroleum Co. 1 Irl Faver, Section 50, Block 21, T&P Survey, Nolan County wildcat 4 miles east of Sweetwater, was unofficially reported to have taken a 30-minute drill-stem test at 5,670-82 ft. in Strawn sand. It was reported that about 1,000 ft. of clean oil, 200 ft. of heavily oil and gas-cut drilling mud and 600 ft. of slightly salty water was recovered. A core was cut at 5,682-92 ft. and the recovery was reported to have carried showings of oil. Frank Buttram 1 Carroll, Section 4, League 359, Goliad County School Land Survey, Jones County wildcat 10 miles south of Hamlin, showed 800 ft. of oil from the Flippen lime at 2,869-72 ft., total depth. A pumping unit was being moved in.

Jones County Regular field, Jones County, had four completions this week. Jones County Regular field had three new lo-

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cations and Reddin field, Taylor County, had two.

WEST CENTRAL TEXAS WILDCAT FAILURES

Coleman County: C. P. Burton 1 C. L. Sounders, J. P. McLean Sur. No. 698, 3 mi. S Silver Valley, elev. 1,982 ft., dry, TD 3,480 ft.

Jones County: Texas 1 C. E. Dickinson, H. B. Williams Sur. No. 273, 3 mi. NW Noodle, elev. 1,825 ft., Swastika 3,141 ft., dry, TD 3,157 ft.

SOUTH LOUISIANA

New Condensate Field Opened in Mud Lake

NEW ORLEANS. — A new condensate pool in Mud Lake area, Cameron Parish, has been opened by Magnolia Petroleum Co. 1-A Lutcher, 32-14s-11w. Drilled to a total depth of 11,923 ft., with perforations at 10,652-60 ft., and 10,617-48 ft., this test flowed 48 bbl. of condensate and 12 bbl. of salt water per day through a 10/64-in. choke. The gas-oil ratio is 42,604 to 1, tubing pressure 3,100 lb., and gravity 59°. Magnolia is preparing to spud its 1-B Lutcher, 800 ft. north of this discovery well in Mud Lake area.

Humble Oil & Refining Co. 1-B J. A. Bel Estate, wildcat Wilcox test in the Oberlin area of Allen Parish, 33-5s-4w, a potential field opener, continues to core and drill ahead from 12,768 ft. in sandy shale.

Union Sulphur Co. 1 Bordages, wildcat test to the Hackberry zone, in 5-10s-9w, Calcasieu Parish, is preparing to perforate for a test at a plugged-back depth of 8,380 ft. Total depth of sidetracked hole is 8,618 ft. and 5½-in. casing has been set on bottom.

There were 18 new locations reported this week, 2 being wildcats, 1 each in Acadia and Cameron parishes, All the 18 completions reported were in proven areas except 1 which opened a new condensate pool in Cameron Parish. Acadia, Calcasieu, and LaFourche parishes showed more activity with three completions each.

SOUTH LOUISIANA SUCCESSFUL WILDCAT

Cameron Parish: New condensate pool, Mud Lake—Magnolia Petroleum 1-A Lutcher, 32-14s-11w, top sand 10,652 ft., TD 11,923 ft., perf. 10,652-60 ft. and 10,617-48 ft., PT 48 bbl. of condensate and 12 bbl. of salt water per day through 10/64-in. choke, gas-oil ratio 42,604 to 1, tubing pressure 3,100 lb., gravity 59°.

CANADIAN FIELDS

Shell's Jumping Pound Well Gets Salt Water

CHATHAM. — In the Jumping Pound field west of Calgary and some 25 miles north and west of the most northerly Turner Valley producer, Shell 10-14-J, LSD 10, 14-25-5w5, encountered salt water in the Madison lime at 10,861 ft. Shell 4-24-J, discovery well, finished last December, got 15,000,000 cu. ft. gas on what was believed to be the crest of the anticline, and the later test was located down structure ⅝ mile southwest, in the belief that the structure was similar to Turner Valley and oil would be encountered down the dip. Results here narrow the possibilities west of discovery. Shell 10-14-J got the Madison at 10,638 ft. and the dark lime at 10,853 ft., contact being about 800 ft. deeper than in the discovery. Shell 4-24-J has a recovery of about 10 bbl. daily.

Turner Valley: Four wells have been completed. They are: West Central: Pacific Petroleums 9, LSD 11, 35-19-3w5, Madison 8,346-8,518 ft., 355 bbl.; North Turner Valley: Royalite-Lowery 3, LSD 4, 11-20-3w5, Madison 8,308-8,550 ft., 288 bbl. daily; North Central Turner Valley: Royalite Oil 82, LSD 4, 1-20-3w5, Madison 6,237 ft., 146 bbl. daily, 40-gravity, 292,000 cu. ft. gas; Royalite 84, LSD 15, 2-20-3w5, Madison 7,426-7,661 ft., around 480 bbl.

Lloydminster.—In the Lloydminster field, east-central Alberta, S.A.C. 2, LSD 1, 12-49-1w4, total depth 1,874 ft., 45 bbl., 14 gravity.

Conrad.—Conrad-Province 31-5-A, LSD 2, 5-6-15w4, total depth 3,019 ft., 60 bbl., 26 gravity. Conrad-Province 13-32-B, LSD 8, 32-5-15w4, total depth 3,096 ft., 98 bbl.

Taber.—Taber-Province 41-22-A, LSD 2, 22-9-17w4, total depth 3,199 ft., 50 bbl. Mid-Continent-British Dominion 1, LSD 6, 27-7-17w4, total depth 3,438 ft., dry. Commonwealth-Taber 1, LSD 11, 22-9-17w4, total depth 3,217 ft., 35 bbl., 26 gravity.

Steveville. — In the Steveville-Princess field, eastern Alberta, National-Empire 1, LSD 10, 34-19-12w4, total depth 3,288 ft., is shutting off a gas flow, estimated 25,000,000 cu. ft., to take oil production.

APPALACHIAN FIELD

West Virginia Gets Four New Gassers

PITTSBURGH.—In Baileysville district, Wyoming County where new gas reserves are being opened in southern West Virginia, Godfrey L. Cabot, Inc., shut

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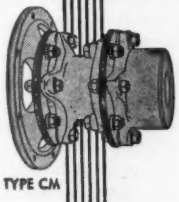

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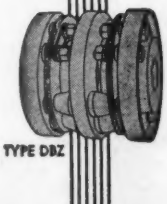

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down at 3,540 ft. to install drilling-in equipment in the test 1,185 N. E. Shields, after a showing of 1,465,000 cu. ft. gas in the top of the Berea. The Ravencliff sand was logged 1,410-32 ft.; gas test 50,000 cu. ft. at 1,410-12 ft.; Big Lime 2,463 ft.; top Berea 3,563 ft. with gas to 3,540 ft.

In this district, Hope Natural Gas Co. is drilling at 3,098 ft. in 8,955 New River & Pocahontas Coal Co., with Ravencliff sand 1,500-32 ft.; gas testing 146,000 cu. ft. at 1,533-35 ft. and 1,538-45 ft.; Maxton 2,313 ft.; Big Lime 2,580-3,000 ft. In Oceana district, this company is drilling 8,871 Loup Creek Colliery Co. at 3,884 ft., with 130,000 cu. ft. gas at 1,956-58 ft. and 1,970-85 ft.; top Big Lime 2,910 ft. with added gas bringing the total to 311,000 cu. ft. In Center district, United Producing Co. completed 1,277 W. M. Ritter Lumber Co., good for 768,000 cu. ft. gas with the Maxton sand 1,797 ft.; Big Lime 2,080 ft.; Berea 3,158-3,202 ft.; gas gaging 263,000 cu. ft. at 3,193 ft.; shot 3,188-96 ft.; total depth 3,210 ft.

In Calhoun County, Z. N. Connolly completed a test on V. B. Boone farm in the Big Lime and Injun sand which is showing for 40 bbl. from total depth 2,208 ft.

In Fayette County, Falls district, Columbian Carbon Co. completed a third test, 803 Gauley Mountain Coal Co. with a final gage of 1,161,000 cu. ft. gas after acidizing the Big Lime, topped at 1,480 ft., with total depth of 1,627 ft.

In North Strabane Township, Washington County, southwest Pennsylvania, Keystone Gas Co. drilled a test on G. A. Markel farm and shut down through the Gantz sand which had a showing for 30 bbl. a day. A time shot was used with fluid tamp from which the rig and expelled oil caught fire and the test is now awaiting new rig for cleaning out. It is located about 2,000 ft. due east of the small Gantz sand oil well on the G. A. Walker farm and about 3,000 ft. east of the new Gordon sand oil pool.

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PERMIAN BASIN

Devonian Pool Opened In Northwest Gaines Co.

MIDLAND.—Amerada Petroleum Corp. 1-A Dr. E. H. Jones, Section 3, Block A-6, Public School Land Survey, Devonian pool opener in northwestern Gaines County, on a 24-hour official test flowed 1,374.54 bbl. of fluid through a 1½-in. tubing choke. The fluid was cut 26.3 per cent water. The gravity of the oil was 43.4° and gas-oil ratio was 284 to 1. The discovery is 7 miles northwest of the Russell pool. Humble Oil & Refining Co. 1-B fee, Section 8, Block A-24, Public School Land Survey, ⅜ mile northwest of 1 fee (M. S. Doss) opener of the Doss pool in south central Gaines, was running 5½-in. casing at total depth of 7,133 ft. in lime. Humble 1-B Eubank, Section 6, Block AX, C. H. Eubanks Survey, 2½ miles northwest of the Doss pool, took a 45-minute drill-stem test at 9,528-9,607 ft. Recovery was 100 ft. of drilling mud with no shows of oil or gas. It was drilling below 9,624 ft. in lime.

Humble has staked 1-B Cowden, 660 ft. from the south and west lines of Section 14, Block X, CCSD&RGNG Survey, an Ellenburger wildcat to be drilled to 10,000 ft. It is 3 miles north of the Crane-Cowden pool in eastern Crane County: Humble 1 Cowden, Section 35, Block X, CCSD&RGNG Survey, wildcat 3½ miles southwest of the new test, was drilling below 8,568 ft. in shale and lime.

Humble 1 Parker, Section 24, Block A-41, Public School Land Survey, ⅜ mile southwest of Sun Oil Co. 1 Martin, opener of the Martin (Clear Fork) pool, is the first producer from the McKee section of the Simpson for Andrews County. It was completed for a natural flow of 577.4 bbl. of 42.3°-gravity oil in 24 hours. Flow was through a ½-in. tubing choke. Tubing pressure ranged from 750 to 110 lb. and casing pressure from 900 to 650 lb. Gas-oil ratio was 630 to 1. Humble will drill a southeast offset to Sun 1 Martin. It is 2 J. E. Parker, 660 ft. from the north and west lines of Section 24, Block A-41, Public School Land Survey. The test is ½ mile due east of 1 Parker.

Shafter Lake field, Andrews County, had eight completions this week while Fullerton field, Andrews County, and McCamey field, Upton County, had three. TXL field, Ector County, reported four locations, Garza field, Garza County, three and Fullerton field two.

WEST TEXAS SUCCESSFUL WILDCAT

Andrews County: New oil pool—Shell and Texas 1 Ratliff & Bedford, Sec. 4, Blk. 73, PSL Sur., 5 mi. NW Three Bar pool, elev. 3,204 ft., dual completion; flowed 1,105 bbl. day through ½-in. choke on 2-in. tubing, perf. 8,777-9,150 ft. Devonian, gravity 42.9°, gas-oil ratio 1,050 to 1, flowed 1,214 bbl. day through ½-in. choke on 2-in. tubing, perf. 11,018-320 ft. Ellenburger, gravity 44.3°, gas-oil ratio 577 to 1, TD 11,469 ft.

WEST TEXAS WILDCAT FAILURES

Gaines County: Union of California 1 Mrs. C. H. Westcott, Sec. 2, Blk. C-44, PSL Sur., 5½ mi. SE Seminole, elev. 3,258 ft., Yates 3,400 ft., dry, TD 3,460 ft.

Kent County: Sohio 1 E. E. Wallace, Sec. 55, Blk. 98, H&TC Sur., 4 mi. NE Clairmont, elev. 2,097 ft., dry in Ellenburger, TD 7,278 ft.

Scurry County: Denver Producing & Refining 1 Otto Hoepfl, Sec. 234, Blk.

(Continued on page 183)

MISSISSIPPI

Two Good Wells Added To Cranfield Pool

JACKSON.—The Cranfield pool of Adams County has been given two good wells this week, one flowing 390 bbl. and the other flowing 306 bbl. of 38.8-gravity oil. The California Co. 11 Lees, 29-7n-1w, perforated at 10,248-285 ft., in the Basal sand, and flowed 390 bbl. of oil in 24 hours through a 5/32-in. choke. In Section 71-7n-1w, The California Co. 8 Ratcliffe ran tubing, perforated and flowed 306 bbl. per day from the Basal sand.

In Alabama, the Carter Oil Co. 1 Sam Alman Unit No. 1, SW SE NE 5-10n-3w, is installing pump after swabbing oil and salt water. A drill-stem test at 3,306-70 ft., in the Eutaw, yielded 240 ft. oil-cut mud, 420 ft. of oil, 180 ft. of salty oil-cut mud, and 60 ft. of salt water. West of this well, the Carter Oil Co. 2 Sam Alman Unit No. 1, SW SW NE 5-10n-3w, is considered dry after swabbing dry from the testing zone at 2,560-2,800 ft. A drill-stem test at 2,609-2,880 ft., open 1 hour, recovered salt water.

Only two new locations have been announced this week, both in Mississippi, one to be drilled in the Cranfield pool of Adams County, and the other in the Langsdale field of Clarke County.

ROCKY MOUNTAIN

Second Ellis Well Completed in Cat Creek

DENVER.—With the completion of a second flowing well in the Ellis formation in the Cat Creek field in Montana this week, the discovery in that horizon four weeks ago takes on greater significance. The discovery was made in Dave Schrock 1 Fifer, NW NW NW 21-15n-30e, which flowed an average of 300 bbl. per day of 51-gravity crude from 2 ft. of the Ellis sand at 1,392-94 ft. The rig was moved to the offset location in NE NW NW of Section 21 for 2 Fifer, where 11 ft. of the sand was drilled without encountering water. The second well topped the Ellis at 1,407 ft. and was drilled to 1,418 ft., with the 6⅝-in. set at 1,387 ft. It flowed 100 bbl. per day initial of clean pipe-line oil. As a result of the showing in these two wells, which are on the east, or Mosby dome, of the three anticlinal highs, Cat Creek, which was nearing depletion after having produced 15,000,000 bbl. of oil from the upper sands, is undergoing a revival of drilling operations. Continental Oil Co., which controls most of the acreage in the field, has made a location for a diagonal offset to the discovery in its 10 Brown, SE SE SE 17-15-30. Schrock is rigging up for his 3 Fifer, a south offset to the discovery, and Ralph Chamberlain is ready to spud in 1 Charles, NE SW NW of Section 21. Dunlop 5-A O'Shea, NE NE 20-15-30, an old second Cat Creek sand producer, will be deepened from 968 ft. to the Ellis.

New operations.—Nineteen new operations were reported for the week, of which 11 are in Montana, 6 in Wyoming, 1 in the Rangely field in Colorado, and 1 at Table Mesa in northwest New Mexico. Four of the Montana operations are around the Ellis sand discovery in Cat Creek, all semiwildcats, and five are in the Cut Bank field. The Wyoming operations are one each in Oil Springs, Lance Creek, Big Muddy, Byron, Garland and Graybull, the latter being a wildcat.

Completions.—Fifteen wells were completed, of which 10 were oil wells with

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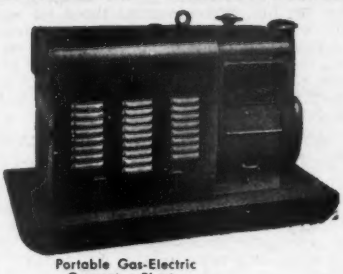

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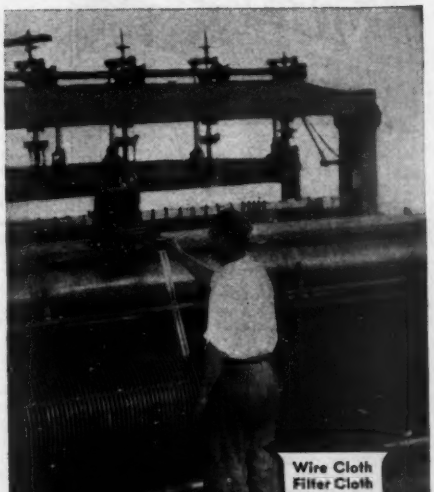

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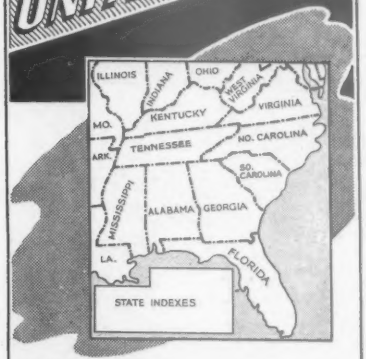

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an initial production of 1,705 bbl., 2 were gas wells and 3 were dry holes. Colorado had two completions in the Rangely field for 794 bbl. Wyoming had three oil wells for 641 bbl. and one dry hole. Montana had nine cimpletions, of which six were oil wells with initial output of 270 bbl., one gas well and two dry holes. Only two wildcats are included, Zimmerman Butte and La Barge, both in Wyoming.

WYOMING SUCCESSFUL WILDCAT

Zimmerman Butte, Hot Springs County: Pacific Western Oil et al 1 Pacific Western, NW SW SW 36-44n-93w, TD 4,332 ft., 7-in. 4,310 ft., top Embar 4,328 ft., flowed 10 bbl. per hour and gradually increased to 14 bbl. per hour, 25.2 gravity.

WYOMING WILDCAT FAILURE

La Barge, Lincoln County: Joe Minton 1 Quealey, SW SW SE 8-26n-113w, TD 1,400 ft., dry.

OKLAHOMA

Garfield County Discovery Drilling in Second Wilcox

ATLANTIC Refining Co.'s 1 Schmidt, wildcat in SE SE SW 25-24n-5w, has drilled into the Second Wilcox, topped at 6,234 ft. After recovering 2 ft. of hard, tight, white sand in coring from 6,238-40 ft., the well was drilled on to 6,307 ft., the present total depth, and was still in the tight sand. However, the last foot of the sand drilled softened up somewhat and is believed to be a water sand. Drilling may be continued to test possibilities of deeper pays in the well. The 1 Schmidt showed good prospects of opening a new field earlier in the week after making a good oil flow and recovery in the First Wilcox at a total depth 6,153 ft.

No promise of increased production has been found in Carter Oil Co.'s new Bromide discovery in south-central McClain County, and operators are continuing to core ahead for formational information. On last gages taken at 10,785-870 ft., the well made 100 bbl. of oil the first hour, 82 bbl. of oil the second hour and 76 bbl. the third hour. No water was recovered during the test. A drill-stem test was made at 10,857-883 ft. and the water load was blown off in the first hour and a half. The well then made 20 bbl. of oil per hour for 2 hours with no water. Latest reported depth was 10,883 ft.

Northward advance of the West Edmond field was halted last week when Magnolia Petroleum Co. 1 Sigl, SW SE 19-15n-4w, Logan County, failed to make a producer. After an acid treatment of the Hunton lime, the well flowed a small amount of oil by heads and was then plugged back to 6,565 ft. where it tested dry.

First Cromwell sand production for the South Extension area of the Sancho pool in Seminole County has been opened by the Candler-Hill 1 Lack, NE NE NW 9-8n-7e, which sprayed an estimated 2,500,000 cu. ft. of gas daily and 20 bbl. of oil into the pits during a short opening flow. Casing was set to the total depth of 3,273 ft. and production was from perforations at 3,250-73 ft. Nearest Cromwell sand production to the new zonal strike is about 2 miles west in 7-8n-7e, where Mealy-Wolfe recently obtained a 200-bbl. well.

OKLAHOMA SUCCESSFUL WILDCAT

Seminole County: New gas field— Gillespie & Sons 1 Patton, SE NW SE 18-6n-8e, 6,136,000 cu. ft. gas from Gilcrease at 2,740-55 ft., TD 4,203 ft., PB 2,910 ft., Gilcrease 2,708 ft., Wapanuka 2,870 ft., Cromwell 2,970 ft.

OKLAHOMA WILDCAT FAILURES

Cotton County: D. H. Bolin 1 Ziegler, NE SW SW SW 23-4s-13w, dry, TD 2,425 ft.
Johnson County: Mid-Continent 1 Bates, NW NE SW 28-4s-6e, junked and skidded southeast for 1-A, TD 1,854 ft.

(Continued on page 184)

LA.-ARK.

Delhi, Lake St. John Get Three New Producers

SHREVEPORT. — Seventeen wells were completed in the North Louisiana fields this week, including eight oil wells, three gas wells, and six dry holes, four of which were wildcats. Delhi and Lake St. John fields received three new producers each. In the Delhi field, C. H. Murphy, Jr., and Sun Oil Co. completed two wells for initials of 281 bbl. and 264 bbl. per day. Gulf Oil Corp. completed A-2 Cooper et al for 657 bbl. from the Paluxy Holt sand at 3,250-63 ft.

In the Lake St. John field, the California Co. brought in two oilers, for 271 bbl. and 288 bbl. respectively. The third well was completed by Carter Oil Co. for 235 bbl. All three wells are producing from the Massive sand and Tuscaloosa.

In the Arkansas fields, six completions were reported. One was a dry wildcat in Union County, and the other five were oil wells in proven territory, the Village pool having two. Four locations have been announced, all for proven areas.

ARKANSAS WILDCAT FAILURE

R. C. Wallingsford 1 Wineman, SW SE SE 13-18s-13w, dry, TD 3,050 ft.

NORTH LOUISIANA WILDCAT FAILURES

Claiborne Parish: H. C. Owens et al 1 Crichton, 604 ft. south and 660 ft.

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SUMMARY OF OCTOBER COMPLETIONS*

	Comp.	Oil	Prod.	Gas	Dry	Under 1,000 ft.	1,000-2,500 ft.	2,500-5,000 ft.	5,000-10,000 ft.	Over 10,000 ft.	Total footage	Rigs and drilling
New York	128	64	110	0	†64	0	128	0	0	0	185,110	152
Pennsylvania	313	164	200	14	‡135	35	252	26	0	0	4,530,016	345
West Virginia	63	6	62	35	22	0	28	33	2	0	176,606	72
Ohio	97	23	698	35	39	13	31	52	1	0	245,090	197
Indiana	13	8	655	0	5	0	6	7	0	0	30,621	66
Kentucky	69	40	3,477	10	19	13	38	18	0	0	115,301	86
Illinois	128	83	10,098	0	45	5	43	80	0	0	329,213	220
Michigan	73	17	6,330	0	56	1	29	42	1	0	188,855	152
Kansas	139	58	20,042	26	§55	0	11	127	1	0	449,590	307
Neb., Mo., Iowa	1	0	0	0	1	0	0	1	0	0	4,580	8
Oklahoma	138	74	11,335	6	§58	8	32	70	27	1	505,139	534
Texas	534	295	89,078	59	180	27	102	178	211	16	2,457,641	1,230
North	132	76	19,255	1	§55	23	59	36	14	0	353,709	216
West Central	26	12	3,757	3	11	0	12	14	0	0	65,292	87
West	113	76	46,364	2	35	1	11	47	46	8	561,511	376
Panhandle	43	16	1,596	26	1	0	0	42	1	0	137,112	110
Eastern	40	16	4,480	12	§12	0	2	7	31	0	247,182	136
Upper Gulf Coast	61	23	4,077	4	34	0	7	6	43	5	401,785	102
Lower Gulf Coast	80	57	8,086	8	15	0	1	10	66	3	528,367	144
South	27	17	1,317	2	8	0	7	13	7	0	103,654	29
South Central	12	2	146	1	9	3	3	3	3	0	39,029	30
Louisiana	85	48	11,477	15	22	2	7	22	40	14	567,104	215
Northern	41	16	3,437	12	13	2	7	21	10	1	170,268	110
Southern	44	32	8,040	3	9	0	0	1	30	13	396,836	105
Arkansas	17	9	1,247	0	8	0	4	7	6	0	81,183	52
Mississippi	29	15	1,653	0	14	0	0	5	21	3	188,738	63
Ala., Ga., Florida	4	1	38	0	3	0	0	1	2	1	28,671	20
Montana	26	17	1,041	3	6	1	15	10	0	0	57,536	82
Wyoming	22	9	1,906	2	11	1	5	10	6	0	84,289	91
Colorado	7	4	1,231	0	3	0	0	1	5	1	47,746	51
New Mexico	43	29	5,743	4	10	3	6	21	12	1	172,610	108
California	165	125	34,638	5	35	9	37	68	38	13	737,980	229
Total October	2,094	1,089	201,059	214	791	118	774	779	373	50	7,106,599	4,280
Total September	2,640	1,389	257,791	292	959	149	903	1,066	470	52	9,099,688	4,200

*Four weeks ending October 27, 1945. Service wells included: †64, ‡128, §1.

east of NW corner of 1-20n-8w, dry, TD 7,019 ft.

DeSoto Parish: Kerlyn Oil 1 Frost, NE SW 7-11n-12w, dry, TD 6,702 ft.

Franklin Parish: C. L. Smith et al 1 McGehee, SW SW 16-11n-9e, dry, TD 8,510 ft.

Madison Parish: McAlester Fuel 1 Brown, 1,980 ft. north and west of SE corner of 44-18n-13e, dry, TD 4,208 ft.

KANSAS

Pawnee County Wildcat Swabbing Arbuckle Oil

HILDEBRAND et al 1 Wickstrom, NW NW NW 12-20-16w, between the Pawnee Rock and Ryan pools of Pawnee County, is opening a new pool for that area, or extending the Pawnee Rock pool. Perforations were made in the Arbuckle at 3,739-41 ft., and operators are swabbing 5½ bbl. of oil per hour.

Pratt County.—Lion Oil Co. 3 Andrews, NW SE SE 24-29-14w, has discovered a new producing horizon for the Coats pool of Pratt County. Arbuckle was topped at 4,298 ft., and perforated at 4,378-90 ft. After acid treatment, the well started flowing at the rate of 35 bbl. per hour. All other wells in the pool are producing from the Simpson sand.

Sumner County.—Paul Hatfield and the Summitt Drilling Co. have taken over Aladdin Petroleum Co.'s 1 Bellman, NE NE SW 15-30-1e, 6 miles east of the Zyba pool. Perforations were made at 3,797-3,813 ft., and the well swabbed 348 bbl. of high gravity oil. The well is making some water, but it is decreasing.

Kansas completions for the week totaled 40, including 21 oilers, 6 gas wells, and 13 dry holes. One gas wildcat was completed, and four wildcats completed as dry. Kraft-Prusa and Chitwood pools each completed two new producers.

KANSAS SUCCESSFUL WILDCAT

Barber County: New gas field—Drillers Gas 1 Lake, W/2 SW SW 1-31-14w, 5,000,000 cu. ft. gas from Maquoketa at 4,401-09 ft., TD 4,409 ft., Massey zone 4,255 ft., Mississippi chert 4,322 ft., Maquoketa 4,400 ft.

KANSAS WILDCAT FAILURES

Barton County: W. L. Hartman 1 Pithner, NW NW NW 13-16-11w, dry, TD 3,429 ft., Arbuckle 3,399 ft.

Douglas County: Volcanic Oil 1 Jackman, NE SE 34-12-19e, dry, TD 2,210 ft., Arbuckle 2,080 ft.

Gove County: Salaws & Modesitt 1 Metz, NE NE NE 26-12-29w, dry, TD 4,762 ft., Arbuckle 4,718 ft.

Graham County: Cities Service 1 McKim,

(Continued on page 177)

OHIO, KENTUCKY

Black Fork Gas Pool Extended to Northeast

COLUMBUS.—The Black Fork gas pool of Lawrence and Gallia counties had another northeast extension in Ohio Fuel Gas Co. 1 Owen Hopkins et al, Sec. 7, Greenfield Township. Clinton sand, topped at 2,864 ft. and drilled to 2,878 ft., gaged 2,940,000 cu. ft. natural. Another location has been approved due north.

A west extension of the Lake Township, Ashland County pool was found by the Ohio Fuel 1 Myrtle Bender, Sec. 20. Upper Clinton at 2,831-2,836 ft. gaged 618,000 cu. ft. natural and shut in at 981,000 cu. ft. after shot.

Of the 20 locations reported for the week, Brush Creek and Stewart fields each had 6. Ashland field led in completions with eight.

The area surrounding the Clayton pool in Perry County is now getting a big play. A number of small oil pools have been found as well as small gas deposits.

OHIO WILDCAT FAILURES

Columbiana County, Butler Township: Natural Gas West Virginia 1 John Wuthrick, Sec. 7, Oriskany 3,656-76 ft., Clinton 5,434-5,537 ft., TD 5,628 ft., dry.

Morgan Township, Morgan County: Stephens Petroleum 1 Edwin Roberts, Sec. 27, Clinton 4,462-96 ft., Medina 4,547-59 ft., TD 4,571 ft., dry.

WESTERN KENTUCKY

OWENSBORO, Ky.—A Henderson County wildcat about 5 miles from other oil producers which seems likely to open a new oil area is the Basin Drilling Co. et al 1 Kasey Club, 8-P-23. The 1 Kasey Club has set casing to test oil saturation found in the McClosky lime at 2,440-48 ft. A 15-minute drill-stem test of this saturation showed 1,025 ft. of gas, 240 ft. of muddy oil and 300 ft. of gas-cut mud. Total depth of the well is 2,461 ft.

EASTERN KENTUCKY

ASHLAND.—Gas-well activities in the eastern Kentucky fields during the week were highlighted by the completion on the David Sparks property, Pike County, by the Kentucky-West Virginia Gas Co. The well, No. 1, was at total depth of 3,082 ft., with daily open flow of 102,000 cu. ft. in shale and 133,000 in Big Lime for a total of 235,000 cu. ft. of gas.

Ashland Oil & Refining Co. completed No. 16 (Northcutt 160 acres) Menifee County, at a total depth of 806 ft., after acidizing for 30 bbl.

Patterson, Dyer & Rader completed No. 3 on the Flannery heirs property, Jackson County, 1,087 ft. for 5 bbl. R. H. Duff completed No. 2 on the D. B. Strong property, Jackson County, 100 ft., dry. South Penn Oil Co. completed No. 5 on the Ewing heirs property, Bath County, 807 ft., 5 bbl.

INDIANA

EVANSVILLE, Ind.—A Posey County well shows promise of extending the New Harmony field about ¼ mile to the west and causing considerable additional drilling in its area. The well, C. A. Lynch-B. M. Heath et al 1 Joel Vail, S½ SW SW 14-5s-14w, is awaiting cable tools to start testing good oil saturation found in the

(Continued on page 179)

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Among the Drilling Contractors

Kigo Drilling Co. is the contractor for Robert J. Hyatt, trustee, 4 Graham et al, 1,200 ft. from the north line and 800 ft. from the east line of NE SE 17-2n-7w, in Daviess County, Indiana.

Cinnabar Drilling & Exploration Co. has been organized by Arthur C. Fisher, Fay L. Wright, J. H. Maurer and V. E. Howe. They were recently granted a permit by the California Corporation Commission.

Martin Harris is preparing to spud the J. H. Gwin 1 Rice, SW SW SW 14-11n-7w, in Cary field, Sharkey County, Mississippi.

A. W. Cherry and **Barron Kidd,** Dallas, has the contract for E. M. Wahlenmaier et al 1 J. W. Barr, southeastern Runnels County wildcat, 1,980 ft. from the south line, 1,946 ft. from the east line of Survey 230, C. Montez original grantee, Abstract 3631.

Dixie Drilling Co. is rigging up for the California Co. 1 Armstrong, 27-7n-1w, in the Cranfield pool of Adams County, Mississippi.

Hewgley Drilling Co. will drill Stanolind Oil & Gas Co. 1 Masonite Corp., SW NE 7-3n-9w, a wildcat in Perry County, Mississippi.

T. T. Eason has the contract for E. A. Obering et al 1 Kettler, SW NW SW 9-4n-6w, in Madison County, Illinois.

C. C. Boatwright, Whittier, Calif., has been awarded contract to drill a wildcat on the Avenal Land & Water property in Kings County, California, for the Kings Exploration Co.

Delta Drilling Co. is rigging up rotary for Iley B. Browning 8 Knight, 12-N-23, in Webster County, Kentucky.

Edwin C. Merrideth is the contractor for Ervin Major 1 Taylor, SW SW NE 32-18n-3e, a wildcat in Bay County, Michigan.

Slaubaugh Brothers, Montgomery, Ind., has the contract for Hoosier Gas Corp. 1 Williams, 990 ft. from the south line and 330 ft. from the east line of SE NE 16-2n-5w, in Daviess County, Indiana.

Penrod Drilling Co. is rigging up for Sun Oil Co. 1 Crapps, 100 ft. west of center of SW NE 25-6s-12e, in Lafayette County, Florida.

C. E. O'Neal, Evansville, will drill the W. E. Stiles 1 Morganfield Coal & Coke Co., 16-O-20, a wildcat in Union County, Kentucky.

Gordon Oil Co. will drill the Ervin Major 1 Charchan, NE NE NW 23-19n-4e, in the Deep River field of Arenac County, Michigan.

George & Wrather will drill the Harry Ames 1 A. Brady Commission, 15-O-21, in the North Waverly pool of Union County, Kentucky.

E. F. Moran, Tulsa, is the contractor for Continental Oil Co. 73 Maier, 11-3s-14w, in Gibson County, Indiana.

Lohman & Johnson Drilling Co., Evansville, will drill the Bristol Hackbusch 2 Reis, 600 ft. from south and east lines of SE NW 19-5s-11w, in Vanderburgh County, Indiana.

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CALENDAR

December

Rocky Mountain Oil and Gas Association, annual meeting, Townsend Hotel, Casper, Wyo., December 7-8.

Independent Natural Gas Association of America, annual membership meeting, Baker Hotel, Dallas, December 10.

Michigan Oil and Gas Association, annual meeting, Mt. Pleasant, December 3.

Interstate Oil Compact Commission, Wichita, Kans., December 13-15.

1946

January

FPC regional hearing in natural-gas investigation, Houston, January 28.

Independent Natural Gas Association of America, annual membership meeting, Texas State Hotel, Houston, January 28.

February

American Welding Society, national meeting, Hotel Cleveland, Cleveland, February 4-7.

Iron and Steel and Institute of Metals divisions, American Institute of Mining and Metallurgical Engineers, national meeting, Statler Hotel, Cleveland, February 4-8.

American Society for Metals, annual convention (postponed from 1945), Statler Hotel, Cleveland, February 4-8.

FPC regional hearing in natural-gas investigation, Biloxi, Miss., February 11.

FPC regional hearing in natural-gas investigation, Chicago, February 19.

American Society for Testing Materials, spring meeting, Pittsburgh, February 25-March 1.

Exposition of Chemical Industries, twentieth exposition, Grand Central Palace, New York, February 25-March 2.

March

FPC regional hearing in natural-gas investigation, Charleston, W. Va., March 19.

Southern Gas Association, annual convention, Galveston, March 21-22.

April

American Association of Petroleum Geologists, annual meeting, Stevens Hotel, Chicago, April 3-4.

Natural Gasoline Association of America, annual convention, Baker Hotel, Dallas, April 17-19.

National Petroleum Association, semi-annual meeting, Hotel Cleveland, Cleveland, Ohio, April 18-19.

May

National Association of Corrosion Engineers, annual meeting, President Hotel Kansas City, Mo., May 7-9.

June

American Society for Testing Materials, annual meeting, Buffalo, June 24-28.

Kansas Fields

(Continued from page 175)

NE NE SW 20-6-23w, dry, TD 7,040 ft., Arbuckle 4,005 ft.

FOREST CITY BASIN

ST. JOSEPH.—Two wildcat oil tests are being drilled in Caldwell County, Mo. O. R. Newcomer 1 Zeikle, C SW NW 27-55n-29w, had the base of Kansas City lime at 208 ft. Elevation is 952 ft. This test is on the west outskirts of the Polo shallow gas pool. About two miles farther west, Todd et al 1 Benson, NW corner 30-55n-29w, had spudded to 64 ft.

Missouri Valley Gas and Oil Co. is deepening 1 Brown, SW NE SE 7-51n-33w, Platte County, Mo. This well was completed in the Peru sand at 554 ft. in 1941 and gaged 2,250,000 cu. ft. It is being deepened and at last report the drill was at 809 ft.

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See Composite Catalog Pages 3101 to 3120

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PERSONALS

Has Filled Foreign Posts Since 1923

ALLEN L. OWENS, new chairman and managing director of The Standard Oil Co. of Egypt, has served in foreign areas for Standard Oil Co. (New Jersey) affiliates since 1923. Following his graduation from University of Missouri in 1917 with a degree in civil engineering, Owens got a job as assistant geologist with Southwestern Petroleum Co. in Tulsa. He had specialized in geology at the university, and in 1918 he joined The Carter Oil Co. in Tulsa as a field geologist, thus beginning a Standard Oil Co. connection which has continued to the present time save for a few months' service with the U. S. Army Engineers.

In 1920 Carter promoted Owens to chief geologist in Parkersburg, W. Va. Three years later he was assigned to Maracaibo as office geologist and acting chief geologist for Standard Oil Co. of Venezuela. In 1927 he was made chief geologist for Trinidad Oil Fields Operating Co., Ltd., in Trinidad, B. W. I. He was there for 12 years and from 1931 was managing director. In 1939 he was transferred to Caripito, Venezuela, as general superintendent and manager for Standard of Venezuela. On December 1, 1942, Owens became general manager of Creole Petroleum Corp. at Maracaibo, retaining that post until his recent appointment to his new position with Standard of Egypt, with headquarters in Cairo.

H. D. Dickson, division civil engineer for Humble Oil & Refining Co., has been transferred from Midland, West Texas division, to Houston, Gulf Coast division. **V. A. Walston,** who was assistant division civil engineer at New Orleans, Louisiana division, has been transferred to Midland and promoted to division civil engineer, West Texas division. **H. E. Meadows** was promoted to Walston's former post. **T. M. Roper,** district chief clerk, was transferred from the Bayou Sale district to the Natchez district, Louisiana division. **O. J. Aucoin** was promoted to Roper's former position.

Comdr. R. A. Townley, on military leave from Socony - Vacuum Oil Co., Inc., is officer in charge of the catapult and arresting-gear spares program for the entire United States fleet. He directs the program from his headquarters at the Naval Air Material Center, Philadelphia, and has had the difficult task of building up at bases scattered all over the world, a supply of replacement parts for the equipment that starts and stops the country's carrier-based aircraft. This mission has taken him to the principal naval activities in the United States and to the Pacific area, where he personally established several bases.

Ross M. Stuntz, who was engineer for Cities Service Gas Co. in Oklahoma City, has been appointed superintendent of production to take the place of **Del Howard,** who resigned to join Republic Natural Gas Co. at Dallas. Stuntz, a graduate of Allegheny College in 1906, started walking pipe lines for Kansas Natural Gas Co. and since then has been in virtually every branch of the natural-gas industry. His assignments include Tampico, Mexico; Prince Edward Island, and Nova Scotia.

Ross W. Thomas, formerly manager of the chemical products department of Phillips Petroleum Co., has been named executive assistant to **G. G. Oberfell,** vice president, with the title of manager of research and development. **George R. Benz,** who was assistant manager of the chemical products department, has been advanced to manager. Thomas joined Phillips in 1926 as construction superintendent. Successively he became research engineer on liquefied petroleum gases, assistant director of research, and vice president and general manager of Philgas Co., which later was made a part of the chemical products department. Since 1940 he also has been president of Hycar Chemical Co., jointly owned by Phillips and B. F. Goodrich Co. Benz started with Phillips in the engineering department in 1925. Later he was made Philgas industrial division manager, and in 1940 was appointed assistant manager of the chemical products department.

Col. Jay Taylor, Amarillo, Tex., oil man, who was drafted for the job of getting oil to Allied mechanized forces, has been awarded the Legion of Merit. Colonel Taylor, now back at his former post as head of Halliburton Oil Well Cementing Co., Duncan, Okla., went to Washington to receive the award. "Colonel Taylor's accomplishments during a period of grave national emergency are in the highest tradition of the military service," said the citation.

E. S. Worthington, secretary-treasurer of Wofford Oil Co. of Georgia, has been chosen secretary-treasurer of the Atlanta control, Controllers Institute of America.

Capt. F. V. Lowden, released from the U. S. Coast Guard Service, has been named veterans coordinator for Standard Oil Co. (N. J.) and its affiliates. He will be responsible for implementing the company's policy in reinstatement of returned veteran-employes. Captain Lowden, in the company's legal department since 1920, was in charge of port security for the Third Naval District during the war.

Chester A. Baird has been appointed resident manager of Venezuelan Atlantic Refining Co. and will assume his new post early in

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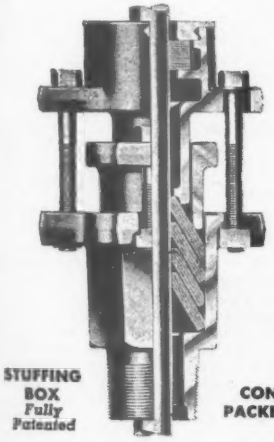

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1946, with headquarters in Caracas. He will have entire charge of the company's activities in Venezuela. Baird, a graduate of Ohio State University, was with various subsidiaries of Gulf Oil Corp. from 1925 to 1944. During the last 4 years of that period he was executive assistant to the president of Mene Grande Oil Co. in Venezuela.

Jesse Hengst, formerly with Barnsdall Oil Co., is now district geologist for Ryan Oil Co. at Evansville, Ind.

O. D. Donnell, for several years chairman of the petroleum industry general committee of District 2, Petroleum Administration for War, was honored at a recent meeting of the committee. A resolution, introduced by **A. W. Peake,** chairman of the supply and transportation committee and expressing appreciation of Donnell's services, was adopted, and a Chelsea clock and barometer were presented to him. Present also at the meeting were **Frank Phillips,** first president of the committee; **E. G. Seubert,** chairman of the district's historical committee; **A. C. Sailstad,** former manager of the committee staff; **E. J. Bullock,** director in charge; **Paul Blazer,** refining committee; **B. L. Majewski,** distribution and marketing committee; and **K. S. Adams,** production committee.

Luis E. Kemnitzer has resumed his practice as consulting geologist in Los Angeles, following 2½ years in military service. He served in England, France, and Germany as economics, trade, and industry officer in military government. His last assignment was with the regional military government for Bavaria, with headquarters in Munich.

Indiana Fields

(Continued from page 175)

Waltersburg sand at 2,106-52 ft. Commercial appearing oil saturation was also found in the Degonia sand at 1,856-68 ft. to make a total of 58 ft. of saturation found in the two sands. Total depth of the test is 2,389 ft.

Magnolia Petroleum 1 El Dike, SW SW SW 25-2s-13w, Gibson County pool opener, has now been completed on pump for 128 bbl. of oil daily after an acid treatment of 2,000 gal. in the Aux Vases lime at 2,654-61 ft. No. 1 Dike is about 4 miles from other deep production in the Keensburg Consol. field.

Another Gibson County wildcat has been successfully completed. It is the Deep Vein Coal 1 Fee, NE NE SE 1-2s-12w. This test was completed on pump for 167 bbl. of oil per day from the Benoist sand at 2,124-38 ft. Total depth is 2,138 ft.

INDIANA SUCCESSFUL WILDCATS

Gibson County: Deep Vein Coal 1 Fee, NE NE SE 1-2s-12w, pumped 167 bbl. oil from Benoist 2,124-38 ft., TD 2,138 ft.

Magnolia Pet. 1 El Dike, SW SW SW 25-2s-13w, pumped 128 bbl. oil, 2,000 gal. acid, Aux Vases lime 2,654-61 ft., TD 2,822 ft.

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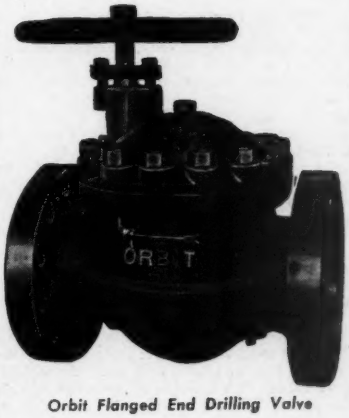
The ease of operation and quick opening — 2½ to 4 turns — of the ORBIT Drilling Valve has made it the number one choice of men in the field. Its dependability and ability to give a positive seat under the severest conditions have made it a must — for safety.



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See pages 2194 to 2211 in 1944 Composite Catalog

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Equipment Men in News

Harry L. Smith, national director of Kelite Products, Inc., Los Angeles firm manufacturing industrial cleaning compounds, returned recently from a 6-week reconnaissance trip through the country. An organization shift added five states to the Kelite Southwest division and two and one-half states to the Midwest group that has headquarters in Chicago.

J. L. Pinkard has joined Rector Well Equipment Co. as sales representative, covering the West Texas territory. He will assist **W. P. Knight**, who has represented the company in this area for many years.

Earl R. Jukes has returned to the Cardwell Manufacturing Co., Inc. He has been reassigned to his prewar position as sales representative in Illinois, Indiana, Kentucky, Ohio.

Leighton Wilkie, chairman of the DoAll Co., announces that training is offered at the DoAll Technical Institute, set up by the company to train men and women in the use of the basic equipment of eight types of community service and repair shops. A model of a shop, as planned by the company, has been set up for inspection by veterans and others interested in owning and operating their own businesses at the DoAll plant, 254 North Laurel Avenue, Des Plaines, Ill.

James E. Sweeney, Kropp Forge Co.'s new general sales manager, entered the sales engineering field in 1931, representing Kropp Forge Co., Wyckhoff Drawn Steel Co., and Granite City Steel Co., serving them in the territory of Indiana, Ohio, and Kentucky until Pearl Harbor.

Selected to aid the work of **C. C. McDermond** as representative for the past 13 years of Axelson Manufacturing Co. of Los Angeles, in Venezuela and Colombia, **Clifford T. McCoy** will represent the firm's line of pumps and sucker rods in Central America.

W. D. Moorer, president of Moorlane Co., Tulsa, Okla., announces the following additions to the company's sales staff in the various offices: **J. Lee Goodridge** and **Ray Thorpe** will headquarter at the main office in Tulsa. Goodridge was previously with Jones & Laughlin Supply Co. Thorpe had formerly been a district manager of sales with Cities Service Oil Co. **W. M. Maxwell**, joining the sales staff at the Kansas City branch of Moorlane, was formerly a valuation engineer with Burns & McDonnell of that city. The sales staff at the Amarillo branch has been increased by the addition of **J. R. Neal** who formerly was an engineer in the materials division with Phillips Petroleum Co. Also joining the Amarillo branch is **C. C. Proctor**, who previously had been connected with a supply company. **J. H. Black** has been assigned to the company's Odessa, Tex., office.

Appointment of **Robert D. Stetson** as manager of the advertising and sales promotion department of Shell Oil Co., Inc., is announced by **L. G. McLaren**, marketing vice president. He succeeds **R. G. (Bud) Landis**, who has been named manager of a newly created motion-picture department.

Nordberg Mfg. Co. announces the appointment of **C. G. Cox** as Pacific Coast manager of its heavy machinery division for such Nordberg products as diesel and steam engines for marine and stationary service, mine hoists and compressors. He will be located at the present San Francisco offices of Nordberg, at 55 New Montgomery Street. **George Lienhard**, in charge of service and installation for Nordberg on the Pacific Coast, will continue in that capacity with the same headquarters at the above address. Sales and service for the crusher division of Nordberg remains at its present location in the Subway Terminal Building, Los Angeles, under the jurisdiction of **T. D. Davis**, Pacific Coast representative of this division.

Announced at its San Francisco headquarters is the formation of Bechtel Brothers McCone Co., a new corporation engaging in the engineering and construction business. Executives and key personnel have been drawn from the Bechtel and the Bechtel-McCone interests. The board of directors consist of **S. D. Bechtel**, **John A. McCone**, **K. K. Bechtel**, **John L. Simpson**, **W. E. Wante**, president; **J. P. Yates** and **Van W. Rosendahl**, executive vice presidents; **Jerome K. Doolan** and **V. G. Hindmarsh**, vice presidents. Offices will be maintained in San Francisco, Los Angeles, and other cities to be announced.

Young Radiator Co. has announced the appointment of **William J. Schlapman** as advertising and sales promotion manager. He has been associated with the company a number of years as sales engineer in the contract department.

D. W. Vernon, who has been general manager of sales for A. Leschen & Sons Rope Co., St. Louis, Mo., since March 1945, has been elected to the board of directors.

American Meter Co. announces promotion of **William G. Hamilton** from assistant manager to manager of the company's Philadelphia factory.

Appointment of **Robert G. Allen** as general sales manager of The Baldwin Locomotive Works has been announced by **Ralph Kelly**, president of Baldwin.

Charles H. Morse, III, has been elected vice president of Fairbanks, Morse & Co. Morse will be in charge of research, traffic, patents, the company's western pump division and the Inland Utilities Co., a Fairbanks, Morse & Co. subsidiary.

The Eagle-Picher Co. announces acquisition of a substantial interest in the common shares of McArthur, Irwin, Ltd.

Harry E. Clark & Co., Houston, Tex., distributor for Strong, Carlisle & Hammond steam specialties, has opened a sales and service branch in Dallas. **Henry L. Litchfield** is in charge of this office and will represent Clark in the Dallas territory.

Bowser, Inc., announces acquisition of the industrial temperature cabinet equipment business of the Kold-Hold Co., Lansing, Mich. The new business will be consolidated with the Refrigeration Division of Bowser, which is located in Long Island, N. Y.

Allegheny Ludlum Steel Corp. plans immediate erection of an ultramodern $2,000,000 research laboratory and experimental center at its headquarters plant, Brackenridge, Pa. Complete air conditioning, including elimination of dust by electrostatic precipitation, will safeguard delicate scientific instruments and complex experiments. The structure is of steel frame and brick design, with double insulating glass windows.

Arthur Purmort, former member of the sales department of Hewitt Rubber Corp., who served during the war in the production and engineering departments, has been moved to St. Louis as district sales manager supervising territories in Missouri, Indiana, Central Ohio, southern Illinois, and Kentucky. **William E. McCue**, who served during the war in the purchasing department and became traffic manager last February, has joined the sales department and is covering the Cleveland and northern Ohio territory. **Robert Crane**, who has been in the Buffalo sales office for a number of years, has been shifted to the Indiana territory, making his headquarters in Indianapolis.

Houston Oil Field Material Co., Inc., recently announced the return from the armed services of **Harris "Tightwad" Lodge**, who will assume the duties of contact man with operators and contractors located in the Houston area. **E. D. Herron, Jr.**, recently returned from service in the Navy, will also undertake sales contact work in the Houston area. **Edward Scown**, another returnee, will function as an engineer, specializing in gas control and recycle work.

Comdr. Herbert M. Shilstone, Jr., returned recently after serving 5 years with the Civil Engineer Corps of the U. S. Navy to assume direction of the Shilstone Testing Laboratory, Houston, Tex. Shilstone Testing Laboratory has newly acquired and staffed a complete oil and gas laboratory at 2817 W. Dallas, Houston, which will broaden the scope of the company to include performance of crude oil evaluations, analyses of petroleum gases by low temperature distillation (Podbielniak), wax determinations, and the usual more common tests. Chief chemist for the Texas activities of the laboratory is **Dr. Charles K. Hancock.**

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